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NEGLECTED OPPORTUNITIES FOR TEAMWORK IN COUNTY HEALTH DEPARTMENT PRACTICE[1]

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Perhaps no term appears more frequently in public health parlance than that of "cooperation." Cooperative effort is commonly spoken of as the keynote of success in all public health activities, but, like so many platitudes, statements in regard to cooperation are often uttered without thought of the mechanisms for their effectuation. With this possibility in mind, the day-to-day operations of three representative county health departments were studied with a view to determining the opportunities for coordinate effort and the extent to which such opportunities were embraced. The most impressive disclosure of the study was the fact that occasions for teamwork exist in all branches of health department activities—in supervision, in cooperative performance of the various employees, and in the follow-up service of individual workers.

Probably the foremost opportunity for teamwork among the health department personnel lies in the direction which supervisors exercise over the staff members of an organization. The character of service rendered by a county health department reflects, in large measure, the amount and quality of supervision practiced. Increased proficiency of staff is the ultimate purpose of supervision. To attain this purpose, three devices are essential: Observing each worker's actual job performance, studying records made out by personnel in pursuance of their duties, and encouraging professional advancement among staff members. Adequate supervision, of course, entails more than the employment of these three essentials. However, certain desirable qualities of a supervisor, such as ability to lead and inspire, are of such intangible nature that measurement is difficult. Furthermore, the present study is not an evaluation of supervision as such, but is concerned with its practice only insofar as it offers occasions for measuring

[1] From the Division of Public Health Methods, National Institute of Health, in cooperation with the Division of Domestic Quarantine.

coordinated health department activity. Each of the afore-mentioned supervisory devices presents an opportunity for cooperative effort on the part of the supervisor and subordinate personnel.

The limited extent to which these opportunities were recognized is apparent from the daily records kept by the health officers, who were directly responsible for supervision. According to these reports, it was possible for the administrators of the three health departments to observe the performance of their personnel upon 680 separate occasions. In only 8 of these instances, however, did the record indicate that the health officer was using the occasion for the purpose of obtaining first-hand information on the way personnel conducted their work. It is recognized, of course, that even though no comment was made of his observation, the health officer might well have noticed the techniques, procedures, skill, and performance of his assistant while performing his own duties on a joint call. Nevertheless, the fact remains that he did not consider this evaluation worthy of mention. Presumably, any supervisory attention was incidental to the real reason for the visit, namely, the service which the health officer himself was called upon to render.

Close supervision of nurses would not necessarily be expected of the health officers if provision for part of that administrative duty had been made through other personnel. Nursing supervision, in a restricted sense, was provided for two of the departments. In one county a consultation service was furnished by the nursing staff of the State health department, but, according to the records of the local nurses, a consultant nurse visited this department only four times in a 12-month period. The visits averaged less than a day in length, and the time was largely spent in office conferences with local nurses and the health officer. Apparently, little attention was given to field observations. No home visits with the consultant nurse were recorded. Opportunities for seeing group or clinic services conducted were presented at only one of the four visits. Accordingly, these visits initiated by the State health department were advisory in nature, and did not provide that first-hand observation so important to improvement of the worker's technique. In another county a senior nurse gave part of her time to overseeing the work of her colleagues; however, for the most part, she had to limit such activities to clinic and other group services. Therefore, in actual practice very little observation was made of the working habits of staff members. As a consequence, only a meager amount of coordinated service could successfully result.

The impossibility of complete supervision without records constitutes one of the fundamental reasons for maintaining them. Detection and correction of such defects as maldistribution of service among the population, improper selection of cases for return visits, or delinquency of patients in clinic attendance rest upon a practice of using

records as an aid to supervision. According to the data at hand, however, by actual performance, records were examined only 92 times for administrative reasons. In 86 of the instances this was necessitated by the preparation of periodic reports to State health departments, a duty that has no immediate bearing on the supervision of personnel by the local health officer.

In much the same manner that treatment complements diagnosis in the field of medical care, staff education complements observation and record study to form the complete picture of supervision, which, concomitantly, encourages cooperation on the part of health department personnel; without corrective measures the effort expended on observation and record study is largely wasted. In-service training activities such as conferences, classes, or study assignments offer perhaps the best opportunity for staff education. Records of conferences provide some data for judging the extent to which such corrective and educational methods may have been employed. In the course of a year 665 occasions were recorded wherein health officers conferred with one or more persons under their direction. The purposes of the conferences were as follows:

Receiving requests for assistance in handling situations	88
Planning, outlining, and discussing program	272
Giving directions and instructions	134
Conferring about vacations, sick leave, resignations, employment, etc	66
Conferring about supplies and equipment	29
Discussing practices or techniques, reviewing knowledge content	20
Determining or discussing policy	14
Miscellaneous	42
	665

Conferences generally included only one or two staff workers, a greater number than this being present on less than 50 occasions. With few exceptions the conferences were informal and brief in character, conducted as exigency demanded. While one cannot eliminate learning from any situation in which two persons exchange ideas, it is a matter for conjecture as to how much improvement of service resulted from contacts which often involved only the assigning of tasks, giving of orders, or receiving of instructions. Other conferences which seem to be rather remote from staff education as to purpose are those held for consideration of vacations, sick leave, resignations, employment, and the like; those devoted to discussions of supplies and equipment; and those where requests were made by the subordinate employee for assistance in handling specific situations. Conferences held for "discussing the program" might well have expanded the worker's horizon if methods suggested for solving problems immediately at hand provided experience for handling similar situations in the future. Perhaps the sessions used for

determining or discussing the department's policy, considering practices or techniques, reviewing knowledge content, and planning or outlining a program offered the best basis for staff education. All three health officers recognized and, in a restricted manner, took advantage of these opportunities. In one county nurses were assigned topics for study immediately related to forthcoming activities, and were invited to discuss these subjects at conferences of the nursing staff. At these sessions the health officer and nurses gave serious consideration to ways and means of improving in-service training activities.

From the foregoing statements it may be seen that certain corrective and educational features of supervision were encompassed by the administrative activities of the health officers. Generally speaking, however, they must have been instituted rather arbitrarily, inasmuch as little direct observation or review of behavior patterns was used as a guide. In all probability, much more fruitful teamwork between the health officer and his staff would have resulted from conferences based upon actual weaknesses of personnel observed by the health officer or discovered by him in perusal of records kept by his staff.

While effective coordination of health department services begins at the top, it is not restricted to the health officer's administrative technique. Additional opportunities for cooperation are found at the staff's operating level through teamwork among the various employees, through coordination of field and clinic activities, and through prompt follow-up of conditions reported by private physicians or other community leaders. It might be assumed that in any organization each employee recognizes in his coworkers special abilities and training for coping with particular problems. Equally important is his recognition of a responsibility for consulting the person best qualified for meeting a specific situation when the individual responsible for a given service finds his own knowledge inadequate. Certainly, in view of these circumstances, numerous occasions for enlisting the aid of coworkers must have occurred in the course of serving 32,179 persons [2] from the 3 study counties. That the value of such procedure was not thoroughly appreciated is apparent when recipients of health department service are analyzed to show number and sequence of contacts by different types of health workers. For example, while 40 percent of the recipients of health department service were contacted by more than one staff member, nearly one-half of these were seen simultaneously by the nurse and dentist or nurse and health officer in connection with a prearranged school program, and not because the first worker considered it advisable to

[2] This number exceeds that reported by Mountin, Joseph W., and Flook, Evelyn: The scope of personal service rendered by 3 representative health departments. The Health Officer (November 1939). The present number (32,179) includes all persons served by special part-time relief personnel, as well as those served by regular health department personnel.

call in the second. An additional 15 percent of those served by multiple workers were contacted in the same manner at other places. Consequently, the type of cooperation under discussion at this time could not have been directly employed in service to more than a small proportion of health department clients. Actually, however, only in rare instances did the records indicate that such cooperation took place. Intervals between visits were such as to argue that the contacts were unrelated to visits by other workers.

Teamwork among health department employees might have been exercised without being apparent from the records of individual clients considered separately. As a matter of fact, the maximum opportunity for cooperative service probably lies in the solving of health problems which affect the entire family. Optimum cooperation exists when the first worker (for example, the public health nurse) visits a home for one particular purpose and during that visit observes and reports another condition which calls for the services of a second staff member (possibly the sanitation officer). The second worker, in turn, promptly investigates the reported situation and performs the service indicated.

Data at hand suggest that this method of coordinating family services was seldom pursued; only 4 percent of all families listed as recipient of health department services were visited in the home by more than one member of the health department staff. Even if every one of these households had represented an instance of referred service, the maximum volume could not be considered of great magnitude. Upon further examination of the conditions prevailing in these homes, it is noted that services rendered by several health department employees to 42 percent of this small group of families were independent of each other and that visits to 25 percent were made coincidentally by two workers. That a majority of the visits were unrelated was determined both by the type of service recorded and by the dates on which visits were made. Obviously, there could be no association between a visit made by the sanitation officer for inspection of premises in October and a post-natal nursing visit made in May. Visits made concurrently by two or more workers do represent a certain form of cooperation, for they were usually the outgrowth of a prearranged program such as medical care in one county, or the milk-control program or tuberculin-testing activities in another. At the same time, this combined type of service obviates the probability that aid or advice concerning a specific problem was sought individually by or from either employee.

Upon the relatively few occasions when expert attention of co-workers was solicited, the problem for which consultation was held was usually one included in a definite program. Thus an organized plan for medical care was responsible for over half of the referred

service which was recorded in one county. The nurse and county physician (assistant health officer) were the two staff members usually involved in administration of the medical care program, and these two workers called upon each other for assistance more often than did any other two health department employees. Even in the counties where no medical care was concerned there appeared to be more teamwork between the health officer and nurse than between any other types of personnel. When a second worker was directed to the home by the first health department visitor, it was almost without exception in reference to the problem already under consideration, and not because a new and separate need of the family had been discovered.

Communicable disease control was given the attention of several staff members more frequently than was any other single problem. Ninety-one of the 211 families receiving referred health department services were visited in connection with a situation of transmissible illness. The aid of associates was seldom sought for conditions other than diphtheria, scarlet and typhoid fevers, and diseases of rather rare occurrence such as Rocky Mountain spotted fever, infantile paralysis, smallpox, and meningitis. The 91 households which received cooperative service represent only a small fraction of the 2,000-odd families attended by health department personnel for communicable disease. The most complete utilization of all health department forces took place in the handling of typhoid fever situations. More than four-fifths of the families supervised by the three health departments because of typhoid fever were visited by two or more staff members working cooperatively for the good of the household and community. When the health officer made the initial investigation, diagnosis of the case was usually followed by a visit from the sanitation officer who investigated the water supply and the condition of excreta disposal facilities. The nurse visited the home for purposes of instructing the family in patient care and contact protection. Less than one-fifth of the families supervised for either diphtheria or scarlet fever were served by a second worker following a visit from the first. Furthermore, in many instances the initiator of service merely quarantined a family and, after a designated period, a coworker went to the home for no other purpose than to terminate quarantine. Under such a system no more was gained from the presence of two workers in that home than if the original person had made the second call.

In addition to the specialized knowledge and abilities of their coworkers, health department employees have access to certain laboratory facilities which are of invaluable aid in determining questionable diagnoses or in confirming a patient's complete recovery

from a transmissible infection. Certainly a truly cooperative program includes the utilization of all such available facilities.

In the counties cited as examples of general health department practice, the number of culture specimens recommended by the Committee on Administrative Practice [3] were collected for only 35 percent of all diphtheria cases and 14 percent of all typhoid fever cases supervised. Here, then, is further unexploited opportunity for cooperative enterprise on the part of a county health organization.

Promptness with which the health department assumes charge of a communicable disease situation [4] is still another measure of the extent to which cooperative activity permeates the program, inasmuch as effectiveness of control is largely dependent upon the punctuality with which the situation is investigated. Records of the study counties suggest that frequently the delay in assuming charge was sufficient to nullify the value of much of the effort expended. Initial visits to approximately one-fourth of this selected group of situations were not made until at least a week after date of onset. The median interval between onset and first health department visit was four days. A lapse of at least six days was frequent, and more than a week's delay in visiting even the more serious communicable disease situations was not uncommon. Greater delay occurred in reaching families with typhoid fever than in visiting those with diphtheria or scarlet fever. In protest against such procrastination, the Appraisal Form for Rural Health Work,[5] at the time of this survey, allowed credit for case investigation only when such activity took place within 24 hours of reporting. It is highly probable, of course, that the delay described was due to tardy reporting of transmissible illnesses rather than to negligence of the health department. Regardless of the cause, lack of harmony is indicated in the actual operation of procedures designed to control communicable illnesses.

In the foregoing discussion, attention has been drawn to many occasions for teamwork among the various health department employees in their daily job performance. When summated, these opportunities may be described as coordination of activities through supervision of the health officer and cooperation of effort among his subordinate personnel. Complete unification of the health department program cannot be attained, however, until the concept of coordinate service is applied by each staff member to his own individual work.

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[3] The Committee on Administrative Practice. Appraisal Form for Rural Health Work. American Public Health Association, New York, 1932.

[4] A situation comprises all of the communicable disease conditions existing in a household and receiving the services of the health department for any one continuous period. One disease or several diseases may constitute a situation, and one person or several persons may be involved. In effect, a situation begins and ends, respectively, with the institution and termination of restrictive and supervisory measures used by the health department in an effort to control communicable disease in a household.

[5] See footnote 3.

The extent to which single workers of these three counties organized their own services by regarding the family rather than the individual as the center of consideration has already been analyzed by Bean and Brockett.[6] Their study was based upon the functioning of the generalized nursing program which is designed to focus attention upon problems of the entire household, thus causing the family to become the unit of service. Little evidence was found to support the claim that the general nurse renders a complete family service. Even when all services furnished a family during the period of an entire year were considered, less than half of the family population were given attention. In one-third of the families only one person was served at any visit, and little thought appeared to have been given to the development of constructive programs for the family as a whole.

Many administrators believe that the use of case records greatly facilitates the coordination of service by individual health department employees. Supposedly, case records constitute a device by which the nurse can plan a daily program; furthermore, they guide her in selection of items for attention on subsequent visits. Failure to use the case records as a basis for selecting cases most in need of return visits is apparent from the data. Many of the individuals for whom case records were prepared received no return visits. At the same time, subsequent visits were made not infrequently to those without case records. Hence, the existence of such a form exerted no outstanding influence upon selection of cases to be visited during the day.

Derryberry [7] cites further evidence of the absence of conscious selection of cases for repeat visits in two of the counties under consideration. Briefly, he reports:

> The data do not bear out the assumption that the items now used on case records serve to remind the nurses of unsatisfactory conditions, and thereby to influence them to return and try again. * * * They do not show any vital association between unsatisfactory conditions in regard to the items listed on the records and repeat visits by the nurse. In making their selection of cases for revisits, the nurses are apparently guided but little by their recorded adverse judgments on conditions which it is their business to observe, inquire into, and improve. The few unsatisfactory items that do appear to influence the nurses are by no means commensurate with the amount of time spent on setting down the details of each case.

Further indication that records kept by the nurses were not utilized for coordinating their work is noted in another of Derryberry's reports.[8] In one county 25 percent and in another, 40 percent of the items recorded as unsatisfactory on the first call were given no grading

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[6] Bean, Helen, and Brockett, Georgie S.: The family as a unit for nursing service. Pub. Health Rep., 52: 1923 (Dec. 31, 1937).

[7] Derryberry, Mayhew: Do case records guide the nursing service? Pub. Health Rep., 54: 66 (Jan. 20, 1939).

[8] Derryberry, Mayhew: Nursing accomplishments as revealed by case records. Pub. Health Rep., 54: 2035 (Nov. 17, 1939).

whatever on subsequent visits. Whether the nurses did not observe these items on repeat visits, or whether they forgot them when making out their records is unknown. In either event, the workers failed to take full advantage of the aid which records are designed to give. If the indicated conditions were not observed, the opportunity for coordination of services was ignored. If, on the other hand, observance was not recorded, the absence of appropriate entries on the form limits the usefulness of the record as a guide to future work.

SUMMARY AND CONCLUSIONS

That there is a direct relationship between economy and effectiveness of health department practices and the degree to which activities of the various staff members are coordinated is self-evident. Nevertheless, a study of the daily activities of three representative rural county health departments reveals that specific occasions for achieving a well-unified service are not commonly recognized. Indexes used for measuring the extent of coordinated activity were as follows: (1) Type of supervision exercised by the health officer over subordinate members of his staff, as expressed in terms of observation of actual job performance, study of service records made out by personnel, and encouragement of professional advancement among staff members; (2) amount of teamwork in which the various workers participated for the control of specific problems, or relationship of visits by several workers to one family; (3) extent to which field and clinic activities were coordinated, (4) promptness with which conditions reported by private physicians were followed up by health department personnel; (5) degree to which the family rather than the individual was recognized as the unit of service; and (6) proportion of case record entries which influenced future service of the worker.

Records kept for the period of 1 year by the personnel attached to the three afore-mentioned health units suggest that innumerable opportunities for teamwork among the staff existed in the course of their routine duties. These same records also indicate, however, that advantage was taken of only a small proportion of these opportunities. Failure to make use of these situations may be ascribed to circumstances such as these: Supervisory activities appear to have been instituted arbitrarily instead of evolving from actual weaknesses of personnel; staff workers apparently pursued individual programs which resulted in isolated rather than integrated performance; the family as a whole was not recognized as the basis of service; and little study was made of records of past service, with a view to guiding future work.

In the light of these disclosures, it appears that closer supervision should be exercised by administrators over the daily performance of individual workers and that the supervisory function of administra-

tion should encourage the different members of local health department staffs to seek the aid and advice of their colleagues upon more numerous occasions. Increased cooperation between private physicians and the health department in establishing control over households with communicable disease is necessary to effective handling of this specific problem. Finally, employees working alone must look beyond the problem immediately at hand and recognize the needs of the family as a unit, making sure that the services rendered represent an outgrowth of findings recorded from previous visits.

STUDIES OF SEWAGE PURIFICATION [1]

XII. METABOLISM OF GLUCOSE BY ACTIVATED SLUDGE

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The factors involved in the removal of glucose from substrates by activated sludge were studied in the previous paper of this series (*1*). It was shown that the rate of glucose removal was a function of the quantity of activated sludge present. Factors influencing the rate of glucose removal and indicating the biochemical nature of the reaction were the necessity for the maintenance of dissolved oxygen and the control of both temperature and pH within common biological ranges. The fact that supplemental feeding of organic nitrogen promoted glucose removal, that starvation by prolonged aeration without food destroyed glucose removal ability, and that a sludge could be acclimated by repeated glucose feeding indicated further the biochemical character of the glucose removal reaction. Ingols' (*2*) experiments also favor the view that the removal of glucose from solution is a biological reaction. The review in the preceding paper (*1*) indicated the lack of knowledge of the glucose removal mechanism and the desirability of such knowledge for the better understanding and operation of the activated sludge process.

It is the purpose of this paper to present the results of a study of glucose metabolism by activated sludge. While bacterial metabolism of glucose is generally considered to be largely dissimilation, Clifton and Logan (*3*) have shown that suspensions and cultures of *Escherichia coli* also assimilate glucose. Both the dissimilative and assimilative mechanisms of glucose metabolism by activated sludge have been considered. The quantities of oxygen utilized, percentages of glucose oxidized, and respiratory quotients during glucose removal have been determined. A search for dissimilation products of glucose has been made and the assimilation of a considerable quantity of the glucose

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[1] Also published in the March 1940 issue of the Sewage Works Journal.

removed from solution has been demonstrated. This assimilative mechanism of the bacterial flocs of activated sludge is suggested as an explanation for the large increase in quantity of activated sludge produced as a result of carbohydrate feeding, which is often followed by sludge bulking.

OXYGEN RELATIONSHIPS DURING GLUCOSE REMOVAL BY ACTIVATED SLUDGE

Oxygen utilization during glucose removal by activated sludge was determined by the method described in an earlier paper (*4*). The quantities of oxygen used in the glucose-fed sludge and in the control sludge were determined simultaneously during aeration. The quantity of oxygen utilized as a result of the attack and removal of glucose is taken as the increment of oxygen absorbed by the glucose-fed sludge. All of the experiments to be described were carried out in 20° C. incubators and the analytical methods employed were the same as in the previous paper (*1*). The oxygen utilization and glucose removal data for a typical experiment in which glucose alone was fed are given in table 1. The quantities of oxygen used by the glucose-fed and

TABLE 1.—*Removal and oxidation of glucose by activated sludge*

Aeration time, hours	Oxygen utilized, p. p. m.			Glucose removed from solution by sludge, p. p. m.	O_2 required (p. p. m.) for complete oxidation of glucose removed	Percentage oxidation of glucose removed	Maximum possible percentage oxidation of glucose by all O_2 used in fed sludge
	Sludge plus glucose	Sludge control	As a result of glucose added				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
½	26.2	9.0	17.2	172.0	194.0	8.9	13.5
1	51.8	17.5	34.3	306.0	326.0	10.5	15.87
1½	62.4	25.0	37.4	406.0	433.0	8.6	14.41
2	85.7	32.6	53.7	471.0	503.0	11.7	17.03
3	103.0	42.8	60.2	660.0	704.0	8.6	14.63
5	125.0	50.0	75.0	895.0	955.0	7.9	13.08
23	247.7	139.9	107.8	896.0	956.0	11.3	25.91

Derivation of data:
(3) = (1) − (2).
(5) = (4) × 1.067.
(6) = (3) × 100 ÷ (5).
(7) = (1) × 100 ÷ (5).

control sludges are given in columns 1 and 2, respectively. The increments of oxygen used in the attack upon glucose are given in column 3 and the quantities of glucose removed from solution in column 4. The quantities of oxygen that would have been required for the complete combustion of the glucose removed were calculated. These values, which are the "L values" or total carbonaceous oxygen demands of the glucose that had been removed at each observation time, are given in column 5. The percentages of these total carbonaceous oxygen demand values of glucose removed which had been

satisfied (oxidized) were calculated and are given in column 6. The maximum possible percentage of oxidation of glucose, if all of the oxygen utilized by the fed sludge mixtures is attributed to glucose oxidation, is given in column 7. These data indicate that only about 11.3 percent of the glucose was oxidized during the 23-hour aeration period in which 896 p. p. m. of glucose were removed from solution. It is noted also that during this removal reaction the fraction of glucose oxidized changes but slightly so that errors in the determinations somewhat obscure the trend.

In some experiments the plant activated sludge was acclimated to glucose by dosing the sludge daily in the laboratory for a few days with sewage containing 500 p. p. m. of glucose. When such sludge was dosed with 1,000 p. p. m. of glucose the sugar was largely removed from solution in the first 1½-hour aeration period. It may be assumed that the low oxidation of glucose found in the experiment in which glucose only was fed was the result of insufficient nitrogen for metabolic uses of the cell. Carpenter (*5*) has recently shown that the ratio of glucose to nonprotein nitrogen used during glucose utilization by the coliform group was about 48 to 1. Assuming that this ratio would also apply to the organisms in activated sludge, about 100 p. p. m. of glycine as a nonprotein source of nitrogen were added with 1,000 p. p. m. of glucose in a number of experiments. The oxygen utilization and glucose removal data for one of these experiments are given in table 2. The percentage oxidation data in tables 1 and 2 are similar. However, the trend toward slightly higher percentage oxidation with increasing time is more evident in table 2 where this percentage increased from 7.0 at 1½ hours to 16.8 in 24 hours. Continuation of the sludge aeration to 40 hours in this experiment did not increase appreciably the percentage of glucose

TABLE 2.—*Removal and oxidation of glucose by activated sludge*

[1,100 p. p. m. of glucose fed to a plant sludge that had been glucose-acclimated]

Aeration time, hours	Oxygen utilized, p. p. m.			Glucose removed from solution by sludge, p. p. m.	O_2 required (p. p. m.) for complete oxidation of glucose removed	Percentage oxidation of glucose removed	Maximum possible percentage oxidation of glucose by all O_2 used in fed sludge
	Sludge plus glucose	Sludge control	As a result of glucose added				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
1½	107.0	26.6	80.4	1,072.0	1,149.0	7.0	9.3
3	146.4	43.1	103.3	1,099.0	1,172.0	8.8	12.5
4½	168.6	58.0	110.6	1,100.0	1,174.0	9.4	14.4
6	187.0	76.6	110.4	1,100.0	1,174.0	9.4	15.9
24	322.7	125.6	197.1	1,100.0	1,174.0	16.8	27.5
40	344.1	146.0	198.1	1,100.0	1,174.0	16.9	29.3

Derivation of data:
(3)=(1)−(2).
(5)=(4)×1.067.
(6)=(3)×100÷(5).
(7)=(1)×100÷(5).

oxidized. Additional experiments were run with and without supplemental nitrogen from which it is concluded that the addition of organic nitrogen with a single dose of 1,000 p. p. m. of glucose to our activated sludge had little if any effect upon the percentage of glucose oxidized.

TABLE 3.—*Summary of results of percentage oxidation of glucose removed from solution by activated sludge*

[All experiments conducted at 20° C.]

Classification of sludge on basis of its glucose removal ability	Experiment No.	Initial pH of fed sludge	Quantity of suspended sludge solids start at p.p.m.	Feed added		Percentage of glucose dose removed during first 1½ hours of aeration	Percentage oxidation of glucose removed in indicated time in hours			
				Glucose, p.p.m.	Supplemental nitrogen		1½	3	4½	23 or 24
Poor	70	7.0	3,422	405	None	10.3	75.6	23.9	31.9	------
Do	74	6.7	1,991	503	do	9.4	49.8	16.8	13.7	20.0
Normal	10	--------	1,940	1,000	None	40.6	8.6	8.6	[1] 7.9	11.3
Do	55	6.6	2,856	1,025	do	10.0	4.5	12.4	9.6	21.2
Do	56	6.3	1,640	997	do	22.7	8.9	9.7	8.8	13.5
Do	58	7.3	3,104	957	do	14.8	------	5.9	4.8	14.8
Do	59	6.9	4,448	1,090	Glycine, 100 p.p.m.	34.8	8.2	11.4	15.8	------
Do	72	6.4	3,128	1,039	None	27.7	12.0	12.1	9.8	12.5
Do	64	--------	2,720	470	do	26.6	11.5	10.2	14.8	21.1
Do	75	7.2	2,522	395	do	59.6	10.3	8.6	13.3	17.3
Do	79	7.4	3,150	935	do	15.4	24.0	24.6	25.9	31.8
Glucose acclimated	62	7.0	2,056	1,108	Glycine, 100 p.p.m.	97.0	7.0	8.8	9.4	16.8
Do	65	7.5	2,334	1,127	do	96.8	5.2	7.9	10.2	18.3
Do	69	7.2	2,131	5,155	1,000 p.p.m. urea.	14.0	11.5	11.3	11.6	------
Do	76	7.3	2,286	402	None	99.7	13.0	14.4	14.7	16.8
Combined average for normal and glucose acclimated sludges							10.4	11.2	12.0	17.8

[1] 5 hours.

Glucose oxidation experiments were also carried out on various activated sludge samples using doses of 400 to 5,155 p. p. m. of glucose. The percentage oxidation of glucose obtained after various aeration periods in each of 15 experiments of this kind is given in table 3. These data indicate that the quality of the sludge used and the quantity of glucose added affect the oxidation percentage of glucose removed from solution during the first few hours of the aeration period. If a dose of glucose up to 500 p. p. m. is added to a sludge which removes glucose at a very low rate, as illustrated in experiments 70 and 74, the indications are that a high percentage of the glucose removed may be oxidized in the first 1½-hour period. Thereafter the percentage oxidized falls for several hours and, after the glucose has all been removed from solution, slowly rises again. The sludge in experiment 70 removed glucose very poorly during the first 1½-hour aeration period, but in other respects this sludge appeared normal. The sludge in experiment 74 was the only bulking sludge used in these experiments. This sludge contained large quantities of *Sphaerotilus*

natans and the sludge index (volume in ml. containing 1 gram of sludge after 30-minute settlement) was 182. The glucose removal and oxidation characteristics of pure cultures of *Sphaerotilus natans* will be discussed in a later paper.

Data obtained in 9 experiments with normal sludge are given in the middle section of table 3. These experiments indicate the tendency of the percentage of glucose removed that is oxidized to increase slowly during the aeration period. The mean percentages of glucose oxidized for these experiments are 11.0, 11.5, 12.3, and 17.9 for the 1½-, 3-, 4½-, and 23-hour aeration periods, respectively. The data obtained with glucose acclimated sludge in experiments 62, 65, 69, and 76 are given in the lower section of this table. The column of this table giving the percentage of glucose removed from solution shows over 95 percent glucose removal in three of these experiments in the first hour and a half. In experiment 69, 5,155 p. p. m. of glucose were fed to a sludge containing 2,131 p. p. m. of suspended solids and even with this extremely high dose 14 percent, or 722 p. p. m., were removed from solution in an hour and a half. The percentages of glucose oxidized with the glucose acclimated activated sludge were very similar to the values for normal sludge.

These values for percentage oxidation of the glucose removed are surprisingly low in view of the velocity of the removal reaction and the belief expressed by Eldridge and Robinson (*6*) that carbohydrates are completely oxidized to CO_2 and H_2O by biochemical oxidation in the activated sludge process. Consequently, experiments similar to the above were carried out with several other bacterial agents capable of attacking glucose. The results obtained are summarized in table 4 and indicate that plant activated sludge oxidized a smaller percentage of the removed glucose than did the other agents used.

TABLE 4.—*Comparison of percentage oxidation of glucose by several bacterial agents after various periods of aeration*

Bacterial agent	Percentage oxidation of glucose removed in indicated time in hours				
	1½	3	4½	10	24
Normal activated sludge	11.0	11.5	12.3		17.9
Pure culture zoogleal sludge [1]	31.0	33.1	33.5		45.1
Bact. coli culture		21.6		28.1	30.6
Bact. aerogenes culture		13.1		31.7	44.6

[1] Mean of seven experiments employing two zoogleal strains.

The percentage oxidation of glucose removed by activated sludge is equivalent to the percentage of the total carbonaceous oxygen demand reduction of a sewage substrate that is actually oxidized under aeration with a nonnitrifying activated sludge as given in an

earlier paper (7). Consequently, a comparison of these values is made below:

Substrate	Percentage of L value reduction that is actually oxidized in indicated time in hours—				
	1½	3	4½ or 5	10	24
Domestic sewage	21.9	31.6	37.9	48.4	57.6
Glucose	11.0	11.5	12.3	----------	17.9

These data indicate a very decided difference in the metabolism of glucose and of sewage by activated sludge. The percentage of the substrate oxidized is much lower for this easily attacked carbohydrate than for sewage. Consequently, a much higher percentage of the glucose removed must be credited to adsorption and assimilation or synthesis.

An experiment which illustrates the difference in the disposal mechanism of glucose and peptone was carried out. In this experiment an 8 liter sample of plant sludge, upon its removal from the plant, was dosed with 500 p. p. m. of peptone, and the oxidation as a result of this feed was determined on portions of this sludge. On the second day 1,039 p. p. m. of glucose were added to the sludge remaining after 1 liter was taken for a control and the oxidation resulting from the glucose dose was determined. On the third day 500 p. p. m. of peptone were again fed and the oxygen utilization of the control and fed portions was again determined. The results are given in table 5. It is noticeable that the oxygen utilization of the control sludge was very similar during the three successive tests. While the oxygen utilization results of the sludge fed with 500 p. p. m. of peptone on the first and third day were very similar, these results were much greater than the quantities of oxygen utilized by the sludge fed with 1,039 p. p. m. of glucose on the intervening day. It is strikingly shown that while larger quantities of glucose than peptone were removed from solution by activated sludge in this experiment, much less oxygen was used during the glucose removal than during peptone removal. Thus while only about 12 percent of the glucose removed from solution was oxidized in 22 hours by activated sludge, over 50 percent of the peptone removed was oxidized during the same aeration time. The experiment also showed no detriment to the peptone oxidizing ability of the sludge by the intervening treatment with 1,000 p. p. m. of glucose. These data again illustrate the difference in the glucose metabolism over that of peptone and sewage.

TABLE 5.—*Comparison of the oxidation of peptone and glucose by activated sludge upon successive days*

Aeration time, hours	Oxygen utilized, p. p. m. Sludge plus feed	Sludge control	As a result of feed	Total B. O. D. of substrate feed removed	Percentage oxidation of substrate removed
FIRST DAY FEED 500 P. P. M. PEPTONE					
1½	72.7	21.1	51.6	207.0	24.9
3	116.4	37.6	78.8	255.0	30.9
4½	153.2	47.7	105.5	289.0	36.5
22	402.7	126.8	275.9	537.0	51.4
SECOND DAY FEED 1039 P. P. M. GLUCOSE					
1½	47.1	10.3	36.8	307.0	12.0
3	86.3	18.8	67.5	557.0	12.1
4½	112.0	34.3	77.7	790.0	9.8
5½	134.0	46.8	87.2	955.0	9.1
22	271.9	134.4	137.5	1,096.0	12.5
THIRD DAY FEED 500 P. P. M. PEPTONE					
1½	81.6	19.2	62.4	207.0	30.1
3	115.9	31.0	84.9	255.0	33.3
4½	158.6	34.5	124.1	289.0	42.9
5½	185.7	39.7	146.0	312.0	46.7
22	414.7	128.3	286.8	537.0	53.4

Another experiment was performed which showed that when activated sludge was dosed with sewage plus glucose very little more oxygen was utilized than when sewage was added alone. Table 6 is self-explanatory and presents the data obtained. In each case the quantities of oxygen utilized as a result of the addition of the feed were obtained by subtracting the quantities of oxygen used by the control sludge portions from the quantities used by the portions fed with sewage and with sewage plus 500 p. p. m. of glucose. It will be noted that 500 p. p. m. of glucose has an oxygen demand L value of 534 p. p. m. and consequently practically doubles the total carbonaceous oxygen demand of the substrate feed when it is added to domestic sewage. Nevertheless, the addition of this carbohydrate load to the sewage did not increase the oxygen utilization appreciably. In fact, the corresponding oxygen utilization figures for the sewage and sewage plus glucose substrates are all within the limits of error of the determinations with the exception of the 3- and 5-hour observation results upon the B portions. Very little more oxygen is needed when 500 p. p. m. of glucose are added to sewage even though all of the glucose is removed during the aeration period.

TABLE 6.—*Quantities of oxygen utilized to oxidize substrate by activated sludge under aeration*

Description of treatment of sludge.	Initial normal sludge taken from plant.		Portion A after dosing daily with sewage for 9 days.		Portion A after dosing daily with same sewage fortified with 500 p. p. m. of glucose for 7 days.	
Oxidation tests upon portions treated as above.	A		B		C	
	Oxygen utilized as a result of the addition of the feed, p. p. m.					
Feed added	Sewage	Sewage plus glucose	Sewage	Sewage plus glucose	Sewage	Sewage plus glucose
Aeration time, hours:						
½	21.6	19.0	9.8	14.3	40.1	32.4
1	30.3	26.8	25.9	28.3	42.7	40.2
3	65.0	64.5	81.6	109.9	65.6	59.0
5	90.2	96.9	123.4	154.5	79.1	79.8
23			324.2	325.3	116.6	117.9

It might be assumed that, because little additional oxygen is used when glucose is added with sewage to activated sludge, the short time oxygen requirement of the sludge would increase rapidly. The quantities of oxygen in mg. used per gram of dry sludge in the control portions of A, B, and C of the above experiment are as follows for the indicated aeration times:

Aeration time (hours)	Mg. O_2 used per gram of sludge		
	A	B	C
½	1.13	2.88	3.42
1	3.03	6.25	9.43
3	9.47	10.28	11.75
5	10.76	10.48	14.80

These results show that the 7 repeated treatments with sewage containing 500 p. p. m. of glucose which sludge portion C received did increase its short-time oxygen demand somewhat over the initial sludge and over the sewage-dosed portion B. However, in a sludge-overloading experiment previously described (*8*), it was indicated that 5-hour sludge demands of 20 mg. of oxygen per gram were perfectly satisfactory. In the above case 5-hour sludge demands of 62.8 mg. of oxygen per gram were obtained when the sludge was badly overloaded. From this it is concluded that dosing sewage containing 500 p. p. m. of glucose daily to activated sludge for 7 days did not produce an overloaded or inferior sludge upon the basis of short-time oxygen demand.

DISSIMILATION PRODUCTS OF GLUCOSE METABOLISM

In several experiments the carbon dioxide produced was determined simultaneously with the oxygen used in both control and glucose-fed sludge mixtures. These experiments gave respiratory quotients of 0.89 to 1.15 for glucose acclimated activated sludge alone and 1.08 to 1.17 for activated sludge-glucose mixtures. These values are in conformity with the respiratory quotient data of Sawyer and Nichols (*9*) upon activated sludge and activated sludge-sewage mixtures. When the carbon dioxide produced as a result of the glucose feed was estimated by the difference method, which has been used for determining the oxygen used to oxidize glucose, the respiratory quotient obtained for the glucose metabolized during a 4½-hour aeration period was 1.04. This is within the experimental error that might be expected of the theoretical respiratory quotient of 1.0 for carbohydrate metabolism. The dissimilation product, carbon dioxide, obtained in these experiments checks the oxidation data and on the average accounts for only about 17 percent of the glucose removed in a 24-hour aeration period. This immediately raises the question of the exact disposition of the large portion of glucose that has been removed from solution but is not accounted for by complete oxidation. The final experiment in the previous section indicated indirectly that little if any of the balance of the glucose remains adsorbed upon the surfaces of the sludge floc. For if much glucose remained in this way the short-time sludge demand would certainly increase rapidly with repeated dosing.

A direct experiment to determine whether glucose remains adsorbed upon the surfaces of the floc was also performed by attempting to recover glucose from sludge in which glucose removal from solution had just been completed. Such a sludge was separated from the supernatant liquor, which contained only 6.0 p. p. m. of glucose, by centrifuging. The separated solids were resuspended in a quantity of distilled water of the same volume as the supernatant removed. The resuspended sludge was boiled for 30 minutes under a reflux condenser and the reducing extracts were determined and calculated in terms of glucose. The results in p. p. m. of glucose obtained are as follows:

Glucose acclimated sludge 3 hours after receiving 1,100 p. p. m. of glucose	Glucose acclimated sludge 4½ hours after receiving 1,100 p. p. m. of glucose	Plant sludge which never had been dosed with glucose
43.3	45.2	58.0

This experiment shows conclusively that the glucose removed from solution is not simply adsorbed upon the surfaces of the sludge floc. At the 3-hour point in this experiment the sludge had just completed

the removal of 1,100 p. p. m. of glucose from the supernatant. The oxygen utilization results have indicated that only about 10 percent of this glucose was oxidized and yet less than 5 percent of the original dose was recovered by extraction with boiling distilled water. The experiment also showed that it was possible to extract as much reducing organic matter from the plant activated sludge as from this glucose-fed activated sludge immediately after the completion of the glucose removal reaction. When the sludges in the above experiment were extracted with boiling hydrochloric acid solution, more reducing material was recovered from the glucose-fed sludge than from the plant sludge. This seems to indicate that the sludge which had removed the glucose contained a larger quantity of a higher nonreducing carbohydrate which was hydrolysed by the boiling acid solution. Even after 30-minute treatment with boiling hydrochloric acid solution, however, less than 20 percent of the glucose equivalent of the original dose could be recovered 3 hours after the glucose was fed. This indicates that a large proportion of the glucose removed from solution is quickly transformed in the bacterial cell to other materials, possibly higher carbohydrates or fats.

It might be assumed that glucose dissimilation of one of the types described by Thaysen and Galloway (*10*) was produced by activated sludge in which soluble, volatile organic acids are end products. Smit (*11*) states that such products could not be found and our efforts to recover volatile organic acids from glucose-fed sludge were also unsuccessful.

Experiments in which glucose removal and total B. O. D. removal were followed simultaneously gave interesting results. In these experiments the 3-, 5-, and 7-day B. O. D. of the supernatant of the sludge was determined initially and 1½, 3, 4½, and 23 hours after glucose feeding. A mean L value or total carbonaceous oxygen demand was calculated from the 3-, 5-, and 7-day B. O. D. results at each observation time and from these data the percentage of the L value removed at each time was calculated. Below, these percentages of the L value removed are compared to the percentages of glucose removal obtained from glucose determinations:

Aeration time (hours)	1½	3	4½	23
Percentage of L value removed	66.6	96.4	97.5	98.8
Percentage of glucose removed	68.7	98.9	98.9	98.9

It will be noted that the greatest difference between the percentage of glucose and of total B. O. D. removed was 2.5 at 3 hours. As about 1,000 p. p. m. of glucose were fed, the maximum quantity of soluble organic products that might have been formed in this experiment would be equivalent to 25 p. p. m. of glucose. This indicates that if

such products are formed they are formed in only extremely minute quantities compared to the quantities of these products formed by the common fermentation processes. For practical purposes it may be considered that the B. O. D. removal of glucose parallels and is equivalent to the glucose removal by activated sludge under aeration. This means that in this process any volatile soluble organic products formed from glucose are either retained by the sludge and are not discharged into the supernatant or that no such products are formed. If volatile organic acids were formed in any quantity and retained by the sludge they would be indicated by a drop in pH and they could be recovered from the sludge by steam distillation. As significant pH drops are not obtained after glucose feeding and volatile acids cannot be recovered by steam distillation, it must be concluded that such products are not formed to any significant extent during the removal and metabolism of glucose by activated sludge.

INCREASE IN ACTIVATED SLUDGE SOLIDS AS A MEASURE OF GLUCOSE ASSIMILATION

As only a small portion of the glucose is oxidized and practically no soluble organic compounds are produced during glucose removal by activated sludge, a very significant increase in sludge solids would be expected. Mention was made in the preceding paper (*1*) of significant increases in sludge solids during glucose feeding. Because of sampling difficulties and errors, special care must be exerted in studying sludge production during glucose feeding. Activated sludge is a biological material in which the basal metabolism continues and the weight of sludge decreases under aeration when it is not fed. Consequently, it is necessary to follow the weight changes in a control sludge and a glucose-fed sludge in studying sludge production during the glucose removal reaction. In our experiments to determine sludge production, 3 or 4 replicate 25-ml. portions of the control and fed sludge liquors were removed and filtered through prepared Gooch crucibles at each observation time. By this means fairly accurate data upon the changes in sludge solids were obtained. In order to reduce the number of samples that needed to be filtered and weighed during a test, factors for converting the oxygen used by the control sludge to solids lost by oxidation were determined. These factors were obtained by observing the oxygen utilized and the suspended sludge solids remaining simultaneously at intervals during aeration of a number of samples of control activated sludge. The mean ratio of sludge solids lost in milligrams per milligram of oxygen used was 1.12. In estimating the activated sludge solids remaining at any time in the control bottles, the quantity of oxygen used to that time was multiplied by the above factor and the result was subtracted

from the initial value for suspended solids. Because of the small loss of solids during short aeration periods in control sludge and the fact that the oxygen utilized data must be obtained in any case, it was preferable to calculate the solids burned in this way rather than to make additional numbers of suspended solids determinations upon the control sludge for each experiment.

TABLE 7.—*Sludge production during glucose metabolism by activated sludge*

[Experiment G-79. Initial suspended solids 3,150 p. p. m. Glucose dose 935 p. p. m.]

Aeration time, hours	Glucose removed from solution, p. p. m.	Oxygen utilized by, p. p. m.		Sludge found in sludge-glucose mixture, p. p. m.	Sludge remaining in control mixture, p. p. m.	Glucose accounted for by increase in sludge solids, p. p. m.	Percentage of glucose removed that is accounted for by—		
		Sludge-glucose mixture	Sludge control mixture				Increase in sludge solids	Oxidation	Increase in solids and oxidation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1½	144	61.9	22.3	3,241	3,125	116	80.6	24.0	104.6
3	280	107.4	33.9	3,320	3,112	208	74.3	24.6	98.9
4½	395	166.8	57.5	3,384	3,086	298	75.4	25.9	101.3
6	508	213.9	67.0	3,446	3,075	371	73.0	27.1	100.1
10	756	325.3	115.4	3,569	3,021	548	72.5	26.0	98.5
24	885	525.2	230.8	3,452	2,891	561	63.4	31.8	94.6

(5) These values are obtained by subtracting the products of the factor 1.12 and column 3 from the initial suspended solids.
(6) = (4) − (5).
(7) = (6) × 100 ÷ (1).
(8) Calculated as shown in column 6 of table 1.

The data obtained in a study of the production of sludge from glucose by aeration with normal activated sludge have been tabulated in table 7. A glucose dose of 935 p. p. m. was given to 3,150 p. p. m. of sludge in this test and column 1 in the table shows that the glucose was removed steadily, the removals obtained ranging from 144 p. p. m. in 1½ hours to 885 p. p. m. in 24 hours. The quantities of oxygen utilized by the sludge-glucose mixture and the control mixture are given in columns 2 and 3. The quantity of sludge found in the sludge-glucose mixture increased regularly during the first 10 hours and decreased somewhat thereafter, as shown in column 4. The rate at which the sludge solids increased and decreased again varies in different experiments and depends upon the rate of glucose metabolism. The quantity of sludge remaining in the control was calculated from the oxygen used in the control as previously described. The quantities of glucose that may be accounted for by an increase in sludge solids as a result of the glucose metabolism increased from 116 p. p. m. after 1½ hours to 561 p. p. m. after 24 hours. The percentages of glucose removed that can be accounted for by the increase in sludge solids and by oxidation are given in columns 7 and 8, respectively. It will be noted that 80.6 percent of the glucose removed is accounted for as an increase in sludge solids after 1½ hours

of aeration and that this percentage falls to 63.4 percent after 24 hours. When the percentage glucose removal accounted for as an increase in sludge solids is added to the percentage accounted for by oxidation, it will be noted (column 9) that practically all of the glucose removed has been accounted for at each observation interval. In fact, the values obtained in this experiment all seem to be within the experimental limits of error. This is not always the case, for in some experiments only 70 to 90 percent of the glucose removed has been accounted for by the data obtained and treated in this manner. However, the percentages of glucose removed that are accounted for by an increase in solids remained very similar to the values given in table 7. The percentages accounted for by oxidation vary considerably as already shown in table 3.

Similar experiments upon the production of sludge during glucose feeding were performed with pure culture sludges formed by single strains of zoogleal bacteria, developed upon synthetic sewage (*4*) which contained no glucose. The data for a typical experiment with such sludge are given in table 8. These data were obtained and treated in the same manner as the data for normal sludge as given in table 7. It will be noted that the percentages of glucose removed, that may be accounted for by solids formation by pure zoogleal cultures, are decidedly lower than for normal activated sludge. On the other hand, the percentage of the glucose removed that is completely oxidized is higher for the pure zoogleal culture than for normal activated sludge. These results warrant the conclusion that there is a definite difference between the aerobic metabolism of glucose by pure zoogleal cultures and that by normal activated sludge. The normal sludge in every case seems to assimilate and synthesize a greater portion of the glu-

TABLE 8.—*Sludge production during glucose metabolism by pure culture zoogleal sludge*

[Strain No. 86. Initial culture solids 686 p. p. m. Glucose dose 505 p. p. m.]

Aeration time, hours	Glucose removed from solution, p. p. m.	Oxygen utilized by, p. p. m.		Sludge found in sludge-glucose mixture, p. p. m.	Sludge remaining in control mixture, p. p. m.	Glucose accounted for by increase in sludge solids, p. p. m.	Percentage of glucose removed that is accounted for by—		
		Sludge glucose mixture	Sludge control mixture				Increase in sludge solids	Oxidation	Increase in solids and oxidation
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1½	71.2	35.6	6.8	702	678	24	33.9	37.9	71.8
3	153.0	63.9	15.4	734	669	65	42.5	29.7	72.2
4½	217.0	89.5	27.0	752	656	96	44.2	27.0	71.2
6	293.0	113.9	27.8	772	655	117	39.9	27.4	67.3
24	438.0	259.6	76.6	800	600	200	45.7	39.0	84.7

(5) These values are obtained by subtracting the product of the factor 1.12 and column 3 from the initial suspended solids.
(6) = (4) − (5).
(7) = (6) × 100 ÷ (1).
(8) Calculated as shown in column 6 in table 1.

cose removed from solution. The quantity of dissimilation products other than CO_2 obtained with both normal activated and pure culture sludge seems to be but a small fraction of the glucose removed.

METABOLISM OF GLUCOSE IN GLUCOSE ACCLIMATED SLUDGE

The acceleration of the glucose removal rate by activated sludge with repeated glucose feeding was first noted by Smit (*11*) and was clearly demonstrated in the previous paper (*1*). It has been suggested (*1*) that one of the reasons for this acclimatization phenomenon was the development of adaptive glucose enzymes by the predominant bacteria of the sludge. To determine whether this might be the case, and whether the glucose metabolism was influenced by such possible acclimatizations, a number of experiments were carried out with pure culture zoogleal sludges. These sludges were developed on synthetic sewage in the bacteriological laboratory. When the cultures contained about 800 p. p. m. of bacterial suspension they were divided into two portions. The feeding of synthetic sewage (containing no glucose) was continued on one portion while the second portion was fed with synthetic sewage fortified with 500 p. p. m. of glucose for 4 or 5 days. The glucose metabolism tests were then made upon these two portions. The glucose removal results obtained in these experiments have been summarized in table 9. These data show that treatment of these cultures for a few days with glucose accelerated very decidedly the rate of glucose removal. These experiments indicate that the mechanism of glucose removal is adaptive for these strains of bacteria and can be accelerated by proper feeding procedures.

TABLE 9.—*The influence of previous glucose feeding upon the removal of glucose from solution by pure culture zoogleal sludge (mean for 3 pairs of experiments)*

[Mean glucose dose, nonacclimated cultures, 493 mg. per liter. Mean glucose dose, acclimated cultures, 485 mg. per liter]

Aeration time, hours	Mg. of glucose removed from substrate per gram of sludge per liter in indicated time		Percentage of the glucose removed from substrate by one gram of sludge per liter in indicated time	
	Nonacclimated	Acclimated	Nonacclimated	Acclimated
1½	158	252	32.0	52.0
3	228	328	46.2	67.6
4½	277	317	56.2	73.6
24	483	439	98.0	90.5

Careful study of data obtained in all glucose metabolism experiments failed to show any difference in this metabolism before and after glucose acclimatization with either normal activated sludge or pure culture zoogleal sludge. The results of all experiments on metabolism with pure culture and normal activated sludge have,

therefore, been summarized in table 10. This table indicates the difference in the mean metabolism of glucose by the two kinds of sludges. It shows that the percentage of oxidation is higher and that the percentage of glucose synthesized is considerably lower for these zoogleal cultures than for normal activated sludge.

TABLE 10.—*Mean percentage metabolism of glucose removed from solution by normal activated sludge and pure culture zoogleal sludge*

Aeration time, hours	Normal activated sludge			Pure culture zoogleal sludge		
	Synthesized to sludge	Oxidized to CO_2	Total accounted for	Synthesized to sludge	Oxidized to CO_2	Total accounted for
1½	77.3	13.6	90.9	39.0	31.0	70.0
3	70.5	14.6	85.1	49.4	33.1	82.5
4½	71.2	15.0	86.2	58.1	33.5	91.6
6	71.2	16.7	87.9	50.7	32.0	82.7
24	73.3	17.8	91.1	48.4	45.1	93.5

POSSIBLE ASSIMILATION PRODUCTS OF GLUCOSE METABOLISM

An attempt was made to determine whether the fat, fatty acids, and hydrogel contents of activated sludge were changed by the prolonged assimilation of glucose. An analysis of activated sludge before and after 60 doses of sewage containing 500 p. p. m. of glucose over a 30-day period was made. All of the glucose fed in this period was metabolized by the sludge. The methods of analysis used by Knechtges, Peterson, and Strong (*12*) for fats and free fatty acids in sludge were employed. The results indicated no appreciable change in either of the above constituents. However, the question of variation or change in the hydrogel content of the sludge has not yet been definitely answered.

DISCUSSION

All of these data indicate that glucose was removed biologically from solution at a much higher rate than oxidation of glucose occurred. With normal activated sludge the glucose was removed from 5 to 7 times as fast as the rate of its decomposition as measured by oxygen consumption and CO_2 production. Zoogleal sludge removed glucose at about three times the rate at which it was oxidized to CO_2. This fact has not been pointed out for activated sludge or zoogleal sludges before. Hawkins and Van Slyke (*13*), however, found that the rate of glucose removal took place more than twice as fast as the rate of decomposition measured by CO_2 production during the initial stages of fermentation by yeasts. Wilson and McLachlan (*14*), in studying the carbon dioxide production in the activated sludge process, express the view that carbon dioxide is not the only product of aerobic oxidation. Following a study of the carbon balance in the process upon a

laboratory scale they conclude that only about 10 percent of the transformation products of carbon appear as CO_2. They suggested the possibility of dehydrogenation in the process but did not demonstrate any dissimilation product other than CO_2. Our data on CO_2 production, while somewhat higher, roughly confirm their findings. Dehydrogenation products of dissimilation, however, could not be found and in this respect our findings confirm those of Smit (*11*). Watkins (*15*) isolated a number of strains of bacteria from activated sludge and sprinkling filter slime which attacked glucose without acid formation as a dissimilation product and it seems probable that these organisms metabolized glucose in a way similar to activated sludge and the pure culture zoogleal sludge.

In a study of the synthesis of cell substance by yeast under vigorous aerobic conditions, Fink and Krebs (*16*) reported a yield of 52 percent of dry substance from 1 percent sugar solutions. Their results indicated that an increase in the percentage of cell substance was obtained as the percentage of sugar was decreased. Winzler and Baumberger (*17*) reached the conclusion that, in the presence of oxygen, yeasts burned 26.5 percent of the glucose which disappeared from the medium and stored 73.5 percent of it as intracellular carbohydrate. This synthesis was demonstrated by the results obtained from the heats of formation and the heat production measured during exogenous respiration. The results of the above investigators upon yeasts with entirely different methods are remarkably similar to the percentages of oxidation and synthesis of glucose obtained on these studies with activated sludge. It is not intended to imply that yeasts are involved in the activated sludge process. While yeasts may be present in the sludge, they are certainly not the predominant organisms. Our data support the work of Winzler and Baumberger in regard to the percentage of glucose that may be assimilated as intracellular carbohydrate in respiring bacterial processes. Werkman (*18*) defines bacterial respiration (aerobic dissimilation) as a process utilizing molecular oxygen as a hydrogen acceptor. The activated sludge metabolism of glucose conforms to this definition. However, in the metabolism of glucose by activated sludge only a small portion of the glucose that disappears is consumed in the respiratory process and a large portion of the glucose is stored. Consequently aerobic dissimilation is descriptive of only the minor portion of this process. As most of the glucose is stored in the process, assimilation and not dissimilation should be emphasized. It would seem therefore that this metabolism can best be described in the terminology of Clifton and Logan (*19*) as an oxidative assimilation. In the words of these authors, the results "suggest that respiration and assimilation are closely connected

processes and the respiration of heterotropic bacteria may well be expressed by the general equation:

$$\text{Foodstuff}+O_2 \xrightarrow{\text{oxidative assimilation}} \text{Assimilated material}+CO_2+H_2O;$$

much as $CO_2+H_2O+\text{light} \longrightarrow (CH_2O)+O_2$ represents the assimilatory process in the green plant."

With glucose the activated sludge process by this oxidative assimilation mechanism transforms over 60 percent of the foodstuff to assimilated material.

It has been shown that glucose was metabolized in a different way than peptone or sewage by activated sludge and that a much greater assimilation and synthesis occurred with glucose than with peptone or sewage. When glucose alone in doses up to 1,000 p. p. m. is fed to normal activated sludge, rapid assimilation occurs and it is inferred that the sludge already contains sufficient nitrogen and mineral constituents to metabolize the glucose. When domestic sewage containing large quantities of glucose (500 to 1,000 p. p. m.) is fed repeatedly to activated sludge, the sewage apparently furnished sufficient nitrogen and mineral constituents for metabolic purposes for the glucose is rapidly assimilated as shown. It is this fundamental difference that explains the much greater production of solids obtained by feeding glucose to activated sludge or pure cultures of zoogleal bacteria. Glucose is not only removed from solution at a somewhat higher rate than peptone but a considerably greater proportion of it is assimilated to appear as protoplasm in either of these biological systems.

Applying the above facts to practical plant operation, the production of larger volumes of sludge would be expected with sewage containing glucose wastes, even in the absence of sludge bulking. The larger the glucose content of the sewage the greater the volume of sludge that is to be expected at the plant for any practical period of aeration. For this reason it is apparent that a ratio of capacities of plant aeration to settling that is satisfactory for domestic sewage might be unsatisfactory for sewage containing carbohydrate wastes. As more sludge is being synthesized from such sewage, greater settling tank capacity would have to be provided, a smaller portion of the sludge produced would be needed for sludge return, and a larger portion would have to be disposed of.

SUMMARY AND CONCLUSIONS

The oxygen relationships of the glucose removal reaction by activated sludge and pure culture zoogleal sludge were studied. It was shown that the percentages of glucose removed that were oxidized varied from 4.0 to 24.0 percent after 1½ hours and from 11.3 to 31.8 percent after 24 hours of aeration with activated sludge. Pure culture zoogleal sludges oxidized on the average 31.0 percent in 1½

hours and 45.1 percent in 24 hours of the glucose that they removed. It was shown that 1,000 p. p. m. of glucose with an L value (total carbonaceous biochemical oxygen demand) of 1,067 p. p. m. when added to a normal activated sludge did not increase the short-time oxygen requirement of the sludge-feed mixture to as great an extent as 500 p. p. m. of peptone with a much lower L value. This is true even when ammonia nitrogen is not being oxidized. This may be explained by differences in the metabolism of these two materials by activated sludge. Repeated feeding of sewage containing 500 p. p. m. of glucose did not increase the short-time oxygen demand per gram of sludge sufficiently to be detrimental to the substrate oxidation ability of the sludge.

A search for dissimilation products of glucose metabolism was made. It was found that once the glucose was removed from solution, it could not be recovered by simple extraction processes. The glucose removal reaction was, therefore, considered to be the result of biological metabolism following adsorption and not simple adsorption upon the surfaces of the floc. The respiratory quotient of glucose metabolism by activated sludge was 1.0. Other dissimilation products besides CO_2 could not be demonstrated by drops in pH during the reaction nor could such products be recovered by steam distillation of the sludge. It was observed that glucose removal and total carbonaceous biochemical oxygen demand removal of glucose were practically equivalent. From this it was concluded that other soluble dissimilation products were either not formed at all or not formed to a sufficient extent to be discharged into the substrate liquor.

The increase in sludge solids was studied as a measure of glucose metabolism and assimilation. Because of the biological character of the reaction, suspended solids were followed in both an activated sludge-glucose mixture and in an unfed sludge mixture as a control. The differences in solids following short periods of aeration represent the glucose assimilation. Such observations indicated that almost 80 percent of the glucose removed is assimilated and appears as protoplasm within 1½ hours of aeration. This percentage of assimilation slowly falls as the aeration is continued, but even after 24 hours over 70 percent of the glucose removed can still be accounted for by the increase in sludge solids. A similar but somewhat lower assimilation and synthesis was demonstrated for pure culture zoogleal bacteria. It was shown that the mechanism of glucose removal by pure zoogleal cultures was adaptive and could be accelerated by repeated doses of a balanced feed containing glucose. An increase in fats or fatty acids could not be demonstrated in sludge which had assimilated glucose for a 30-day period. From 80 to 100 percent of the glucose removed can be accounted for as the sum of the glucose oxidized and that assimilated to protoplasm. On the basis of these experiments,

it must be concluded that the removal of glucose from solution by normal activated sludge and pure cultures of zoogleal bacteria is largely an oxidative assimilation reaction. In this reaction the greater part of the glucose is assimiliated and appears as protoplasm within the sludge in a few hours after the glucose is fed. Dissimilation products other than carbon dioxide cannot be demonstrated during this metabolism and, upon the basis of these data, can in any case represent only a relatively small fraction of the glucose metabolized.

ACKNOWLEDGMENTS

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INFECTIOUS EQUINE ENCEPHALOMYELITIS IN THE UNITED STATES IN 1939

Although equine encephalomyelitis may have existed in the United States for a great many years,[1] attention was recently focused on the disease by the outbreak in Massachusetts in 1938, in which human cases of encephalitis also occurred. Of 38 suspected human cases investigated, 8 were proved, 5 of which, occurring within 15 miles of each other, were concentrated in the area in which the equine disease was prevalent. There was no indication of human contact infection in these cases.[2] Mosquitoes were reported to have been unusually prevalent at the time of the outbreak.

In 1939, Dr. McAdams and Dr. Porter, of Fall River, Mass., reported a case of encephalitis in an adult in which the etiological agent was isolated and proved to be identical with that of the virus of the eastern type of equine encephalomyelitis.[3] They believed this to be the first reported case in a human adult proved in this manner.

In view of the probable relationship between infectious equine encephalomyelitis and encephalitis in human beings, and the epidemiological factors involved, information regarding the incidence, mortality, and distribution of the equine disease in the United States is of especial interest to public health officials and research workers. In a recent report,[4] Dr. J. R. Mohler presents some interesting data for 1939, compiled from responses to questionnaires sent to the various State livestock sanitary officials and Bureau of Animal Industry inspectors.

In 1939, only 8,008 cases of equine encephalomyelitis were reported in the United States, or only about 4 percent of the number of cases (184,662) reported in 1938. There were 2,471 deaths from the disease. These figures give a case rate of 1.1 per 1,000 animals (horses and mules) in the affected counties, and a case fatality of 30 percent.[5]

[1] Transmission of encephalomyelitis in the horse and possible vectors in the human being. By James Stevens Simmons. New Eng. J. Med., **22**: 956–958 (Jan. 8, 1939).

[2] Outbreak of encephalitis in man due to the eastern virus of equine encephalomyelitis. By R. F. Feemster. Am. J. Pub. Health, **28**: 1403–1440 (December 1938).

[3] Encephalitis in man caused by the virus of equine encephalomyelitis. By James C. McAdams and Joseph E. Porter. New Eng. J. Med., **221**: 163–166 (Aug. 3, 1939).

[4] Report on infectious equine encephalomyelitis in the United States in 1939. By J. R. Mohler, Bureau of Animal Industry, Department of Agriculture. Mimeographed statement, January 20, 1940.

[5] In these computations some States with incomplete mortality records are excluded.

The total numbers of animals in the affected counties were approximately the same for the 2 years (7,654,149 in 1938 and 7,159,491 in 1939). In 1939 every State west of the Mississippi River was involved, and approximately one-third of all counties or parishes in the entire country reported infected animals.

In general, the highest incidence rates were reported for counties in the far western and Pacific States, a northeast-southwest strip of Central States, and three Atlantic States, New Jersey, North Carolina, and Florida.

The case fatality rate for the eastern type of virus was apparently more than 3 times as high as that for the western type. In 24 States where only the western type has been proved or suspected, the case fatality was 26.7 percent, as compared with 89 percent in 9 States where only the eastern type has been proved or suspected. Limited, but apparently significant, figures show an average of 22.6 percent fatality in animals under 1 year as compared with 37.4 percent in those over 1 year of age.

As in previous years, over 90 percent of the cases were reported to have occurred during the summer or early fall. Of the cases reported during other months, only one (in Florida in January) was confirmed in the laboratory. This seasonal prevalence tends to support the prevailing conception regarding the principal natural means of transmission, by blood-sucking insects, especially mosquitoes.

The reported incidence of encephalomyelitis in vaccinated and unvaccinated horses and mules was 0.37 and 1.2, respectively, per 1,000 animals. It was estimated that no less than 3,000,000 horses and mules (about one-fifth of the total in the United States) received specific prophylactic treatments, some of which animals were undoubtedly in the incubation stage of the disease at the time of vaccination. Two 10-cc. doses of formolized chick-embryo tissue vaccine, given at intervals of 7 to 10 days, were commonly used.

In commenting on the possible factors influencing the reduction in the incidence of equine encephalomyelitis in 1939 as compared with 1938, Dr. Mohler considers vaccination one of the major factors, and suggests, in addition, the retarding of insect breeding as the result of low precipitation rates, and increased resistance among animals due to frank attacks in preceding epizootics.

INFANT DEATH RATES IN THE UNITED STATES, BY STATES, FOR 1938 AND PRIOR YEARS

According to figures recently issued by the Bureau of the Census the infant mortality rate for continental United States was 51.0 in 1938, the lowest rate since the birth registration area was established in 1915 and undoubtedly the lowest in the history of the country.

The report of the Bureau of the Census presents the numbers of infant deaths and the rate (per 1,000 live births) for each year from 1915 to 1938, but in the accompanying table the rates are given by 5-year periods from 1915 to 1935 and by year for 1935 to 1938. In 2 years, 1916 and 1918, the rate was above 100. Since 1918 it has been reduced almost 50 percent.

As is the case with the general mortality rate, the infant mortality rate for the country as a whole obscures unnecessarily high rates in

Infant death rates (number per 1,000 live births) by States, 1938 and comparison with prior years [1]

Area	1915	1920	1925	1930	1935	1936	1937	1938
Birth registration area [2]	99.9	85.8	71.7	64.6	55.7	57.1	54.4	51.0
Alabama	([3])	([3])	([3])	72.1	62.8	66.8	62.4	60.8
Arizona	([3])	([3])	([3])	116.6	111.7	119.6	120.7	98.8
Arkansas	([3])	([3])	([3])	51.5	47.1	50.9	54.5	51.4
California	([3])	74.4	68.7	58.7	49.6	53.1	53.8	43.7
Colorado	([3])	([3])	([3])	94.3	72.7	74.1	73.5	60.2
Connecticut	107.1	91.9	73.3	56.0	42.7	42.0	40.4	36.3
Delaware	([3])	([3])	90.5	78.5	66.4	64.5	63.8	52.8
District of Columbia	111.1	91.0	87.4	70.8	59.4	72.4	60.8	48.1
Florida	([3])	([3])	74.2	64.2	61.9	59.4	59.8	57.9
Georgia	([3])	([3])	([3])	77.4	68.3	70.0	61.7	67.7
Idaho	([3])	([3])	([3])	57.1	51.0	51.4	43.7	44.6
Illinois	([3])	([3])	72.5	55.8	45.9	46.8	43.1	40.9
Indiana	([3])	81.8	67.9	57.7	50.8	50.7	49.7	42.5
Iowa	([3])	([3])	56.0	53.9	47.1	48.2	44.2	40.5
Kansas	([3])	73.1	61.7	52.6	50.3	51.8	44.4	43.0
Kentucky	([3])	73.1	70.5	65.4	58.7	66.8	59.1	61.3
Louisiana	([3])	([3])	([3])	78.2	60.4	71.9	65.6	67.1
Maine	[illegible]	101.6	76.3	75.7	63.0	64.1	65.3	56.2
Maryland	[illegible]	104.1	90.0	75.3	62.0	69.1	61.5	55.7
Massachusetts	[illegible]	90.9	73.0	60.1	48.3	46.5	44.1	39.9
Michigan	86.0	91.7	75.3	62.7	47.7	50.7	47.9	44.6
Minnesota	70.2	66.4	60.3	52.5	44.7	44.4	40.8	38.8
Mississippi	([3])	([3])	68.5	67.7	53.9	58.2	58.9	56.7
Missouri	([3])	([3])	([3])	58.6	56.9	57.9	56.5	51.5
Montana	([3])	([3])	70.9	58.5	60.0	57.0	50.5	45.5
Nebraska	([3])	64.2	57.7	49.4	41.2	44.1	42.1	36.4
Nevada	([3])	([3])	([3])	68.3	71.0	69.8	40.2	47.7
New Hampshire	109.6	88.0	76.2	61.4	53.9	46.2	48.1	47.6
New Jersey	([3])	([3])	68.9	56.5	46.2	44.3	39.4	39.5
New Mexico	([3])	([3])	([3])	145.4	120.3	121.8	123.7	108.7
New York	99.3	86.3	67.6	58.8	48.0	47.0	45.1	40.6
North Carolina	([3])	84.9	78.8	78.6	68.8	68.9	65.5	68.6
North Dakota	([3])	([3])	71.6	61.7	59.4	49.7	52.4	49.8
Ohio	([3])	82.9	69.6	60.7	50.4	51.2	49.6	43.3
Oklahoma	([3])	([3])	([3])	60.7	54.6	60.0	56.6	49.0
Oregon	([3])	61.8	51.1	50.0	41.2	44.3	41.5	39.2
Pennsylvania	109.8	97.1	82.0	68.0	50.8	51.2	50.3	45.9
Rhode Island	120.3	([3])	72.8	61.8	47.2	48.2	47.6	43.8
South Carolina	([3])	115.8	([3])	88.7	79.3	80.8	75.6	80.3
South Dakota	([3])	([3])	([3])	([3])	52.5	47.8	51.1	43.8
Tennessee	([3])	([3])	([3])	75.7	64.0	68.5	61.1	63.5
Texas	([3])	([3])	([3])	([3])	71.7	71.2	73.9	65.1
Utah	([3])	71.4	55.8	57.4	49.3	52.7	41.4	46.8
Vermont	85.5	96.2	72.4	64.8	48.6	58.0	49.5	48.4
Virginia	([3])	83.6	80.8	77.3	69.6	73.9	69.7	66.2
Washington	([3])	66.4	56.4	48.7	45.2	45.4	39.9	38.7
West Virginia	([3])	([3])	79.8	81.0	60.6	71.2	61.8	62.3
Wisconsin	([3])	76.5	67.2	55.7	46.0	47.7	43.4	41.8
Wyoming	([3])	([3])	63.9	69.3	51.1	57.6	55.6	51.8

[1] Vital Statistics—Special Reports, Bureau of the Census, Department of Commerce, vol. 9, No. 15 (Jan. 19, 1940).
[2] In continental United States.
[3] Not in the birth registration area.

certain population groups and in certain localities. In 1 State the rate is still over 108, though it has decreased from 145 in 1930. The next highest rate for 1938 is 98.8, while 11 other States have rates over 60. The lowest rate is 36.3, although only 6 other States have a rate under 40.

These figures represent a great accomplishment in public health work during the past 25 years in reducing infant mortality, in which the reduction in the number of deaths from diarrhea and enteritis has been an important factor. The death rates for other causes, however, such as premature birth, injury at birth, and even bronchitis and pneumonia, have been reduced very little during that period. There are still hazards of birth and early infancy that are amenable to control; and there are still groups of our population for which better facilities should be provided and greater effort expended in the conservation of infant lives.

THE AMERICAN SOCIAL HYGIENE ASSOCIATION, 1939

The year 1939 marked the twenty-sixth year of national service by the American Social Hygiene Association. This voluntary health organization, founded in 1914 by merging existing national organizations in the field, and with President Charles W. Eliot of Harvard University as its first president, first led the battle against the venereal diseases and has played an important role in changing the policy of silence and inaction to one of public and frank attack on these diseases.

The American Social Hygiene Association conducts its activities of venereal disease control in various fields, and closely cooperates with official agencies. It directs special efforts toward informing the citizens, mobilizing effective local voluntary units, encouraging the passage and enforcement of laws designed to prevent and control venereal disease, giving consultant services—medical, public health, and legal—and improving sex education in schools.

In 1939 the Association aided in 5,000 Social Hygiene Day meetings, secured the printing of 20,000 news stories, editorials, or other items in papers and magazines, distributed 1,245,000 pamphlets, 5,554 books, and 48,540 charts and posters, and sponsored and distributed films that were shown to audiences aggregating over a million people.

In mobilizing the citizens for the fight against venereal diseases, 15 members of the Association traveled 130,000 miles into 500 counties of 48 States, increased the number of local social hygiene groups from 145 to 159, and increased its own paid membership by 37 percent over the number in 1938, the best previous year in this respect.

The Association has actively encouraged and promoted the passage of laws requiring premarital examinations and blood tests of expectant mothers, 9 additional States being added to the first category in 1939 and 14 to the latter. The legal staff gave aid and counsel to numerous State and local groups regarding social hygiene legislation and compiled a 400-page summary of venereal disease control legislation in the 48 States.

The consultants of the medical staff conducted a study of the distribution, use, and value of Federal assistance to States and cities for venereal disease control, visited hospitals on Indian reservations, and gave lectures in cooperation with medical and nursing societies. Support has been given to significant research in the urgent basic medical problems of syphilis and gonorrhea.

The program of the American Social Hygiene Association fits in with and supplements the Federal program. The funds for the latter go for the improvement and expansion of local official health services in the fight against the venereal diseases, whereas the Association engages in activities in fields more suitable for effective voluntary organization.

Requests upon the Association for services far exceed the financial ability to meet them all. Its modest budget of $220,000 for 1940 seems small in comparison with the immensity of the task to be done. "We have made no more than an energetic beginning in a war that should enlist the sympathy and active cooperation of every community."

Any one interested in the specific activities of the Association during 1939 may obtain such information by requesting a copy of "How Social Hygiene Reached Out to Millions in 1939" from the American Social Hygiene Association, 50 West Fiftieth Street, New York, N. Y.

EIGHTH AMERICAN SCIENTIFIC CONGRESS

Washington, D. C., May 10-18, 1940

The Eighth American Scientific Congress which will convene in Washington, D. C., May 10-18, 1940, will not only serve as a forum for the scientific thought of the Western Hemisphere, but it will signalize the fiftieth anniversary of the founding of the Pan American Union. All American republics, members of the Pan American Union, have been invited, and are expected to participate.

The first scientific congress of international scope in the history of the Western Hemisphere was held in Buenos Aires in 1898, in connection with the celebration of the Silver Jubilee of the Argentine Scientific Society. It was through the initiative and enlightened cooperation of scientists and officials of the Argentine Republic that there was

conceived and executed the plan of calling together periodically the scientists of other American countries for discussion and exchange of ideas regarding problems of mutual interest.

The Pan American Union, the semicentennial of which is being memorialized as a part of the program of the Congress, was designed primarily to serve as the agency for collecting, tabulating, and publishing information concerning commercial production and concerning the laws and regulations of the respective member nations. The scope of the activities of the Union has been increased, however, to include virtually every phase of human activity, scientific, economic, juridical, cultural, and social, and it has been an effective agent in promoting cordial relations between the nations of the Western Hemisphere.

The agenda for the Eighth American Scientific Congress will include eleven sections, as follows:

I. Anthropological Sciences; II. Biological Sciences; III. Geological Sciences; IV. Agriculture and Conservation; V. Public Health and Medicine; VI. Physical and Chemical Sciences; VII. Statistics; VIII. History and Geography; IX. International Law, Public Law, and Jurisprudence; X. Economics and Sociology; and XI. Education.

Of especial interest to health officers and other persons concerned with public health will be the program of Section V, Public Health and Medicine, of which Surgeon General Parran is chairman. The tentative outline of the program of this section, with key topics and subtopics for each session, already arranged or anticipated, is as follows:

Saturday, May 11, A. M.:

General topic: *Education.*

The bearing of popular, higher, professional, and special education upon medicine and public health. (Joint session with Section on Education.)

Monday, May 13, P. M.:

General topic: *Nutrition.*

Summaries on status of recognized avitaminoses. Relation between nutritive state and some aspects of heart disease. Relation between drinking water and dental caries and mottled enamel. Recent observations on ariboflavinosis.

Tuesday, May 14, A. M.: Joint session with Statistical Section.

P. M.: Visit to National Institute of Health. Observation of current investigations in many branches. Visitors may concentrate, if they desire, on subjects of personal professional interest.

WEDNESDAY, MAY 15, A. M.:

General topic: *Tuberculosis.*

Social and economic factors in etiology. Changes in clinical types encountered. Constitution of tubercle bacillus and its antigenic fractions. An epidemiological paradox of tuberculosis and possible explanations. New methods of treatment.

P. M.

General topic: *Chemotherapy.*

Chemistry and pharmacology of new compounds. Clinical applications to infections with streptococci, gonococci, pneumococci, meningococci, to lymphogranuloma venereum, and other infections. Experimental results of promise.

THURSDAY, MAY 16, A. M.:

General topic: *Heart Disease.*

New conceptions from clinical viewpoint. Epidemiological features of rheumatic heart disease. Incidence and importance of etiologic forms of heart disease. Physiologic considerations of resuscitation.

P. M.

General topic : *Cancer.*

Present status of experimental cancer. Organization for cancer study and control. Newer aspects of therapy.

FRIDAY, MAY 17, A. M.:

General topic: *Tropical and other diseases.*

Summaries and new contributions on yellow fever, pinto, leprosy, undulant fever, rickettsial diseases, plague.

DEATHS DURING WEEK ENDED MARCH 16, 1940

[From the Weekly Health Index, issued by the Bureau of the Census, Department of Commerce]

	Week ended Mar. 16, 1940	Corresponding week, 1939
Data from 88 large cities of the United States:		
Total deaths	8,960	9,544
Average for 3 prior years	9,304	
Total deaths, first 11 weeks of year	105,008	104,790
Deaths under 1 year of age	426	565
Average for 3 prior years	566	
Deaths under 1 year of age, first 11 weeks of year	5,732	6,122
Data from industrial insurance companies:		
Policies in force	66,021,448	67,772,489
Number of death claims	13,652	18,305
Death claims per 1,000 policies in force, annual rate	10.8	14.1
Death claims per 1,000 policies, first 11 weeks of year, annual rate	10.7	10.9

PREVALENCE OF DISEASE

No health department, State or local, can effectively prevent or control disease without knowledge of when, where, and under what conditions cases are occurring

UNITED STATES

REPORTS FROM STATES FOR WEEK ENDED MARCH 30, 1940

Summary

For the current week, the influenza incidence again declined, with 4,087 cases reported, as compared with 4,438 for the preceding week and with a 5-year (1935–39) median of 4,770 cases. The highest incidence has been persistently maintained in the South Atlantic and South Central groups of States.

As compared with the preceding week, slight increases were shown for measles, scarlet fever, and whooping cough, although all of the 9 diseases remained below the median expectancy based on the experience of the 5 years 1935–39. The accumulated totals for the first 13 weeks of the current year of all of these diseases except influenza and poliomyelitis are also below the median totals of the preceding 5 years. The total number of smallpox cases reported this year to date is approximately one-fourth of the median expectancy, measles about one-half, meningococcus meningitis less than one-third, and typhoid fever about two-thirds of the expectancy.

Of a total of 19 cases of poliomyelitis reported for the current week, 4 cases occurred in Texas and 3 cases each in California and Utah, while no more than 1 case was reported from any other State.

Three cases of Rocky Mountain spotted fever were reported in the Mountain States and 2 cases of brucellosis (undulant fever) were reported in Maryland during the current week.

Telegraphic morbidity reports from State health officers for the week ended March 30, 1940, and comparison with corresponding week of 1939 and 5-year median

In these tables a zero indicates a definite report, while leaders imply that, although none were reported, cases may have occurred

Division and State	Diphtheria			Influenza			Measles			Meningitis, meningococcus		
	Week ended		Median, 1935–39	Week ended		Median, 1935–39	Week ended		Median, 1935–39	Week ended		Median, 1935–39
	Mar. 30, 1940	Apr. 1, 1939		Mar. 30, 1940	Apr. 1, 1939		Mar. 30, 1940	Apr. 1, 1939		Mar. 30, 1940	Apr. 1, 1939	
NEW ENG.												
Maine	7	1	1	4	22	13	424	31	132	0	1	0
New Hampshire	0	0	0	------	------	------	144	0	43	0	0	0
Vermont	0	0	0	------	------	------	9	43	43	0	0	0
Massachusetts	2	3	3	------	------	------	359	1,008	632	1	2	2
Rhode Island	0	1	0	------	------	------	158	9	120	0	0	1
Connecticut	0	0	4	6	7	9	134	717	707	0	1	1
MID. ATL.												
New York	16	14	27	[1] 15	[1] 41	[1] 22	560	1,467	2,867	2	4	8
New Jersey [3]	10	6	16	16	5	19	461	55	1,338	0	0	2
Pennsylvania	25	35	38	------	------	------	215	119	1,337	7	5	5
E. NO. CEN.												
Ohio	3	37	33	97	------	20	25	32	584	2	2	8
Indiana	6	6	14	27	84	55	10	9	137	3	0	6
Illinois	19	36	36	33	73	52	82	33	106	2	1	4
Michigan [3]	3	20	12	3	243	6	318	393	393	0	2	2
Wisconsin	0	0	1	202	544	59	292	562	562	0	2	1
W. NO. CEN.												
Minnesota	2	0	4	3	14	1	214	708	394	0	0	1
Iowa	2	7	7	9	156	8	341	160	160	0	0	1
Missouri [3]	2	11	16	1	27	110	7	5	41	0	0	2
North Dakota	1	2	1	6	149	9	1	44	19	0	0	0
South Dakota	2	1	0	1	33	0	1	171	4	0	1	0
Nebraska	3	4	3	------	2	0	58	214	80	0	0	0
Kansas	0	4	5	4	66	23	580	37	37	1	1	1
SO. ATL.												
Delaware	0	0	0	------	------	------	0	0	15	0	0	0
Maryland [3]	2	3	5	41	67	57	4	589	204	1	1	6
Dist. of Col.	3	1	11	3	2	2	0	124	52	1	0	2
Virginia	6	19	16	484	930	------	203	421	421	1	1	7
West Virginia [3]	5	9	10	138	512	67	17	18	52	2	0	4
North Carolina	22	11	11	57	37	37	145	808	271	1	0	1
South Carolina	3	6	5	455	1,265	533	3	57	38	1	2	1
Georgia [3]	8	8	7	90	1,086	336	155	172	0	1	2	2
Florida	8	4	4	13	25	25	193	186	57	2	0	1
E. SO. CEN.												
Kentucky	6	8	8	64	259	102	71	30	151	2	1	9
Tennessee	2	11	11	153	424	132	66	82	82	3	2	4
Alabama [3]	10	2	5	231	2,502	674	130	175	175	3	2	3
Mississippi [3]	12	3	4	------	------	------	------	------	------	0	3	1
W. SO. CEN.												
Arkansas	6	1	1	254	697	130	12	78	78	1	2	2
Louisiana [3]	7	11	12	31	11	34	32	189	99	0	1	1
Oklahoma	7	7	5	197	343	162	7	260	111	1	0	1
Texas [3]	26	24	38	1,154	2,440	436	789	393	393	1	2	3
MOUNTAIN												
Montana [4]	1	2	2	43	198	22	35	166	22	0	0	0
Idaho	2	0	0	------	76	11	39	222	18	0	0	1
Wyoming [4]	1	4	2	------	1	1	37	151	28	0	0	0
Colorado	5	8	8	11	30	------	27	272	272	0	0	0
New Mexico	0	3	3	1	101	19	53	26	87	0	0	1
Arizona	5	2	2	137	391	64	104	30	30	0	0	0
Utah [3]	0	1	0	13	95	------	417	150	24	0	0	0
PACIFIC												
Washington	1	1	1	------	------	1	891	703	190	0	1	0
Oregon	9	2	1	28	79	69	620	58	58	1	1	0
California	14	19	23	62	553	417	444	4,154	1,046	2	1	5
Total	274	358	453	4,087	13,590	4,770	8,887	15,331	15,331	42	44	173
13 weeks	4,942	6,566	7,754	149,029	113,646	99,074	76,869	167,831	167,831	520	682	1,652

See footnotes at end of table.

Telegraphic morbidity reports from State health officers for the week ended March 30, 1940, and comparison with corresponding week of 1939 and 5-year median—Con.

Division and State	Poliomyelitis			Scarlet fever			Smallpox			Typhoid and paratyphoid fever		
	Week ended		Median, 1935–39	Week ended		Median, 1935–39	Week ended		Median, 1935–39	Week ended		Median, 1935–39
	Mar. 30, 1940	Apr. 1, 1939		Mar. 30, 1940	Apr. 1, 1939		Mar. 30, 1940	Apr. 1, 1939		Mar. 30, 1940	Apr. 1, 1939	
NEW ENG.												
Maine	0	0	0	15	20	20	0	0	0	0	9	2
New Hampshire	0	0	0	1	7	10	0	0	0	0	0	0
Vermont	0	0	0	9	15	15	0	0	0	2	0	0
Massachusetts	0	0	0	163	171	287	0	0	0	0	2	1
Rhode Island	0	0	0	17	0	29	0	0	0	0	1	0
Connecticut	0	0	0	106	86	116	0	0	0	2	0	1
MID. ATL.												
New York	0	1	1	994	748	997	0	3	0	9	5	5
New Jersey [3]	0	0	0	448	181	221	0	0	0	1	0	3
Pennsylvania	1	0	1	548	373	571	0	0	0	7	8	5
E. NO. CEN.												
Ohio	1	0	1	431	732	440	3	25	0	5	2	2
Indiana	0	0	0	252	202	202	5	40	10	0	3	2
Illinois	1	1	1	857	483	861	3	18	18	3	9	5
Michigan [3]	0	0	1	310	562	522	0	18	9	6	2	2
Wisconsin	0	0	0	145	186	304	3	4	6	0	1	1
W. NO. CEN.												
Minnesota	0	0	0	80	107	158	2	15	13	1	0	1
Iowa	1	0	0	75	112	209	23	34	34	1	0	0
Missouri [2]	0	0	0	29	83	182	2	26	26	2	0	0
North Dakota	0	0	0	5	15	31	3	3	5	3	1	0
South Dakota	0	0	0	13	14	23	1	7	7	0	0	0
Nebraska	0	0	0	19	44	44	3	11	11	0	0	0
Kansas	0	0	0	63	109	138	0	12	12	0	0	0
SO. ATL.												
Delaware	0	0	0	16	9	9	0	0	0	0	0	0
Maryland [3]	0	0	0	38	40	74	0	0	0	2	2	3
Dist. of Col.	0	0	0	16	21	21	0	0	0	0	0	0
Virginia	0	0	0	32	22	54	0	0	0	2	5	4
West Virginia [3]	1	0	0	41	42	61	0	0	0	2	4	4
North Carolina	0	0	0	33	30	30	0	0	0	2	1	3
South Carolina	0	0	0	5	4	5	0	0	0	3	0	1
Georgia [2]	0	0	0	20	18	13	3	1	1	0	4	3
Florida	1	1	0	8	8	8	1	0	0	2	4	2
E. SO. CEN.												
Kentucky	0	0	0	111	63	57	0	3	1	2	3	3
Tennessee	0	0	0	94	67	27	0	10	1	1	3	2
Alabama [2]	0	0	0	18	9	9	1	4	1	3	3	3
Mississippi [3]	1	0	0	7	4	10	0	0	0	2	2	2
W. SO. CEN.												
Arkansas	0	0	0	4	5	10	1	3	2	1	1	1
Louisiana [3]	0	0	0	19	7	10	0	1	1	6	28	15
Oklahoma	0	0	0	11	33	24	3	40	1	0	1	2
Texas [3]	4	0	2	37	57	75	5	40	13	5	5	6
MOUNTAIN												
Montana [4]	1	0	0	29	19	19	0	5	5	3	0	1
Idaho	0	0	0	14	8	11	0	3	3	0	1	1
Wyoming [4]	0	0	0	4	7	17	0	1	2	0	0	0
Colorado	0	0	0	44	34	71	7	7	7	0	0	0
New Mexico	0	0	0	22	11	17	0	0	1	3	0	0
Arizona	1	0	0	14	3	5	0	9	0	0	1	1
Utah [3]	3	0	0	12	23	47	0	0	0	0	0	0
PACIFIC												
Washington	0	0	0	24	57	45	0	2	15	1	0	2
Oregon	0	0	0	20	18	38	1	20	12	0	8	1
California	3	0	3	149	195	213	2	17	9	4	2	4
Total	19	3	24	5,416	5,064	7,609	72	382	328	86	121	128
13 weeks	353	187	277	61,523	68,971	88,382	954	4,902	3,982	1,002	1,527	1,527

See footnotes at end of table.

Telegraphic morbidity reports from State health officers for the week ended March 30, 1940, and comparison with corresponding week of 1939 and 5-year median—Con.

Division and State	Whooping cough	
	Week ended	
	Mar. 30, 1940	Apr. 1, 1939
NEW ENG.		
Maine	33	70
New Hampshire	10	0
Vermont	34	42
Massachusetts	150	228
Rhode Island	8	101
Connecticut	25	83
MID. ATL.		
New York	319	506
New Jersey [2]	82	459
Pennsylvania	380	349
E. NO. CEN.		
Ohio	223	209
Indiana	41	33
Illinois	118	331
Michigan [3]	120	174
Wisconsin	97	201
W. NO. CEN.		
Minnesota	27	49
Iowa	7	12
Missouri [2]	4	12
North Dakota	27	0
South Dakota	2	1
Nebraska	9	9
Kansas	17	8
SO. ATL.		
Delaware	16	2
Maryland [3]	174	19
Dist. of Col	7	35
Virginia	32	52
West Virginia [3]	69	27
SO. ATL.—continued		
North Carolina	69	286
South Carolina	15	111
Georgia [2]	28	51
Florida	20	35
E. SO. CEN		
Kentucky	50	20
Tennessee	36	46
Alabama [2]	33	54
Mississippi [3]		
W. SO. CEN.		
Arkansas	18	31
Louisiana [2]	25	2
Oklahoma	3	4
Texas [2]	243	130
MOUNTAIN		
Montana [4]	1	2
Idaho	25	4
Wyoming [4]	5	2
Colorado	5	57
New Mexico	31	12
Arizona	29	11
Utah [3]	105	35
PACIFIC		
Washington	38	19
Oregon	24	9
California	258	177
Total	3,092	4,110
13 weeks	37,830	54,751

[1] New York City only.
[2] Typhus fever, week ended March 30, 1940, 11 cases as follows: New Jersey, 1; Missouri, 1; Georgia, 2; Alabama, 2; Louisiana, 1; Texas, 4.
[3] Period ended earlier than Saturday.
[4] Rocky Mountain spotted fever, week ended March 30, 1940, 3 cases as follows: Montana, 1; Wyoming, 2.

WEEKLY REPORTS FROM CITIES

City reports for week ended March 16, 1940

This table summarizes the reports received weekly from a selected list of 140 cities for the purpose of showing a cross section of the current urban incidence of the communicable diseases listed in the table.

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Data for 90 cities:											
5-year average	155	678	125	7,983	923	2,444	31	399	22	1,234	--------
Current week [1]	73	321	66	1,837	496	1,869	2	379	14	866	--------
Maine:											
Portland	0	------	0	50	1	0	0	0	0	6	28
New Hampshire:											
Concord	0	------	0	0	0	0	0	0	0	0	14
Manchester	0	------	0	25	0	0	0	0	0	0	15
Nashua	0	------	0	62	0	0	0	0	0	0	8
Vermont:											
Barre	------	------	------	------	------	------	------	------	------	------	------
Burlington	0	------	0	0	0	0	0	0	0	0	12
Rutland	0	------	0	0	1	0	0	0	0	0	6
Massachusetts:											
Boston	0	------	1	31	6	21	0	10	1	45	212
Fall River	0	------	0	35	1	1	0	1	0	2	33
Springfield	0	------	0	0	0	9	0	0	0	20	35
Worcester	0	------	0	3	6	8	0	1	0	0	50
Rhode Island:											
Pawtucket	0	------	0	0	0	1	0	0	0	0	11
Providence	0	------	0	112	6	10	0	1	0	5	62
Connecticut:											
Bridgeport	0	------	0	0	2	3	0	1	0	0	31
Hartford	0	------	0	1	0	9	0	0	0	5	35
New Haven	0	4	0	1	1	1	0	0	0	2	43
New York:											
Buffalo	0	------	0	3	8	18	0	6	0	3	130
New York	17	33	5	70	95	647	0	91	1	110	1,585
Rochester	0	2	0	2	1	20	0	0	0	11	51
Syracuse	0	------	0	0	7	12	0	2	0	8	62
New Jersey:											
Camden	0	------	1	0	3	11	0	0	0	1	27
Newark	0	3	0	139	4	18	0	12	0	11	111
Trenton	0	1	2	0	2	3	0	0	1	2	50
Pennsylvania:											
Philadelphia	4	10	3	20	19	79	0	29	3	51	523
Pittsburgh	0	4	3	1	9	27	0	5	0	2	176
Reading	0	------	0	0	2	0	0	0	0	10	14
Scranton	1	------	--------	0	--------	2	0	--------	0	0	--------
Ohio:											
Cincinnati	0	1	0	2	7	15	0	8	0	17	145
Cleveland	1	48	2	2	11	21	0	10	1	18	219
Columbus	1	2	2	1	9	7	0	1	0	12	107
Toledo	0	1	1	1	8	23	0	3	1	12	78
Indiana:											
Anderson	0	------	0	0	0	1	0	0	0	3	11
Fort Wayne	0	------	1	0	2	1	0	4	0	1	32
Indianapolis	2	------	0	5	13	20	0	7	0	10	108
Muncie	0	------	0	0	4	2	0	0	0	0	19
South Bend	0	------	0	0	2	1	0	0	0	2	13
Terre Haute	0	------	0	0	0	1	0	0	0	2	11
Illinois:											
Alton	0	------	0	0	0	0	0	1	1	0	16
Chicago	5	10	2	25	38	492	0	38	0	43	727
Elgin	0	------	0	0	0	3	0	0	0	0	7
Moline	0	------	0	0	0	2	0	0	0	0	14
Springfield	0	------	0	1	3	2	0	0	0	0	26
Michigan:											
Detroit	1	3	0	28	16	71	0	7	1	11	273
Flint	0	------	0	0	4	10	0	0	0	15	21
Grand Rapids	0	------	0	5	2	17	0	1	0	6	36
Wisconsin:											
Kenosha	0	------	0	4	0	0	0	0	0	0	11
Madison	0	------	1	1	0	4	0	0	0	8	15
Milwaukee	0	------	0	6	7	27	0	2	0	8	123
Racine	0	------	0	0	0	2	0	0	0	0	10
Superior	0	------	0	79	0	5	0	0	0	0	5

[1] Figures for Barre, Boise, Tacoma, and San Francisco estimated; reports not received.

City reports for week ended March 16, 1940—Continued

State and city	Diphtheria cases	Influenza Cases	Influenza Deaths	Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
Minnesota:											
Duluth	0	----	0	132	1	5	0	0	0	1	25
Minneapolis	4	----	1	2	6	31	0	0	0	6	106
St. Paul	0	1	1	0	8	8	0	2	0	7	77
Iowa:											
Cedar Rapids	0	----	----	8	----	1	0	----	0	0	----
Davenport	1	----	----	3	----	5	0	----	0	0	----
Des Moines	1	----	0	6	0	4	3	0	0	0	39
Sioux City	0	----	----	0	----	0	0	----	0	0	----
Waterloo	1	----	----	0	----	0	0	----	0	0	----
Missouri:											
Kansas City	0	1	1	1	3	17	0	8	0	1	91
St. Joseph	0	----	0	0	1	0	0	1	0	1	24
St. Louis	3	1	1	1	9	30	0	5	0	7	204
North Dakota:											
Fargo	0	----	0	2	0	0	0	0	0	0	6
Grand Forks	0	----	----	0	----	0	0	----	0	1	----
Minot	0	----	0	1	0	0	0	0	0	0	6
South Dakota:											
Aberdeen	0	----	----	0	----	0	0	----	0	0	----
Sioux Falls	0	----	0	0	0	1	0	0	0	0	9
Nebraska:											
Lincoln	1	----	----	0	----	2	0	----	0	2	----
Omaha	0	----	0	5	7	1	0	0	0	0	49
Kansas:											
Lawrence	0	7	0	0	1	0	0	0	0	0	4
Topeka	0	----	0	1	6	3	0	1	0	0	27
Wichita	4	2	0	241	3	2	0	0	0	2	39
Delaware:											
Wilmington	0	----	0	2	2	6	0	0	0	1	24
Maryland:											
Baltimore	1	25	2	1	23	12	0	19	0	181	222
Cumberland	0	----	0	0	0	0	0	0	0	0	12
Frederick	0	----	0	0	0	0	0	0	0	0	3
Dist. of Col.:											
Washington	6	1	1	5	9	18	0	11	0	15	153
Virginia:											
Lynchburg	0	----	0	0	5	0	0	1	0	12	16
Norfolk	0	12	0	2	7	2	0	0	0	9	37
Richmond	1	----	2	0	3	2	0	3	0	0	42
Roanoke	0	----	0	0	1	3	0	0	0	0	21
West Virginia:											
Charleston	0	----	0	0	1	0	0	2	0	0	28
Huntington	0	----	----	0	----	1	0	----	0	0	----
Wheeling	0	----	0	0	3	1	0	1	0	1	27
North Carolina:											
Gastonia	0	----	----	0	----	0	0	----	0	0	----
Raleigh	0	----	0	0	0	0	0	2	0	0	12
Wilmington	0	----	0	0	1	0	0	0	0	0	9
Winston-Salem	0	----	0	0	1	1	0	1	1	3	16
South Carolina:											
Charleston	1	46	1	0	0	1	0	0	0	0	28
Florence	0	----	0	0	4	0	0	0	0	0	17
Greenville	0	----	0	0	7	1	0	2	0	0	34
Georgia:											
Atlanta	1	18	3	3	6	1	0	3	0	1	92
Brunswick	0	----	0	0	0	0	0	1	0	0	5
Savannah	2	15	3	0	3	0	0	2	0	0	35
Florida:											
Miami	0	7	0	0	1	0	0	4	0	0	47
Tampa	0	----	0	122	1	2	0	1	0	2	32
Kentucky:											
Ashland	0	6	0	0	2	0	0	0	0	1	8
Covington	0	----	0	1	2	3	0	3	0	0	16
Lexington	0	----	0	0	0	1	0	0	0	1	17
Louisville	0	1	0	0	12	26	0	0	0	39	77
Tennessee:											
Knoxville	0	12	1	1	2	12	0	1	0	0	23
Memphis	0	5	0	4	3	21	1	2	2	12	66
Nashville	1	----	1	8	9	6	0	2	0	6	58
Alabama:											
Birmingham	1	9	1	3	6	1	0	2	0	0	63
Mobile	0	5	3	0	1	1	0	0	0	0	21
Montgomery	1	37	----	5	----	0	0	----	0	0	----
Arkansas:											
Fort Smith	0	12	----	0	----	0	0	----	0	0	----
Little Rock	0	1	0	0	6	0	0	0	0	0	7

City reports for week ended March 16, 1940—Continued

State and city	Diphtheria cases	Influenza		Measles cases	Pneumonia deaths	Scarlet fever cases	Smallpox cases	Tuberculosis deaths	Typhoid fever cases	Whooping cough cases	Deaths, all causes
		Cases	Deaths								
Louisiana:											
Lake Charles	0	------	0	3	1	0	0	1	0	0	9
New Orleans	0	6	4	13	22	9	0	9	0	29	194
Shreveport	0	------	1	0	3	1	0	2	0	0	51
Oklahoma:											
Oklahoma City	0	3	0	0	7	0	0	1	0	0	48
Tulsa	0	------	------	0	------	1	0	------	0	18	------
Texas:											
Dallas	3	9	4	27	8	3	0	3	0	21	66
Fort Worth	0	------	1	0	4	1	0	0	0	22	33
Galveston	1	------	0	4	4	2	0	0	1	0	15
Houston	1	3	0	3	4	4	0	4	0	1	92
San Antonio	1	4	6	55	9	1	0	5	0	2	77
Montana:											
Billings	0	------	0	0	1	0	0	1	0	0	15
Great Falls	0	------	0	1	2	2	0	0	0	0	10
Helena	0	------	0	0	0	0	0	0	0	0	3
Missoula	0	1	0	0	0	1	0	1	0	1	6
Idaho:											
Boise	------	------	------	------	------	------	------	------	------	------	------
Colorado:											
Colorado Springs	0	------	0	1	3	2	0	0	0	0	11
Denver	3	------	4	7	11	6	0	3	0	2	93
Pueblo	0	------	0	0	0	4	0	0	0	1	3
New Mexico:											
Albuquerque	0	------	0	0	1	0	0	3	0	9	11
Utah:											
Salt Lake City	0	------	0	126	2	7	1	3	1	44	26
Washington:											
Seattle	0	------	0	349	2	7	0	2	0	24	105
Spokane	0	------	0	0	2	11	0	1	1	1	31
Tacoma	------	------	------	------	------	------	------	------	------	------	------
Oregon:											
Portland	6	2	1	189	5	3	0	2	0	8	90
Salem	0	------	------	6	------	0	0	------	0	0	------
California:											
Los Angeles	5	43	3	27	7	26	0	24	0	19	368
Sacramento	0	2	1	2	2	4	0	2	0	14	29
San Francisco	------	------	------	------	------	------	------	------	------	------	------

State and city	Meningitis, meningococcus		Poliomyelitis cases	State and city	Meningitis, meningococcus		Poliomyelitis cases
	Cases	Deaths			Cases	Deaths	
Massachusetts:				Maryland:			
Boston	0	0	1	Baltimore	1	1	0
New York:				Virginia:			
New York	0	0	1	Norfolk	1	1	0
Ohio:				West Virginia:			
Cincinnati	1	0	0	Charleston	2	1	0
Columbus	0	1	0	Florida:			
Illinois:				Tampa	1	0	0
Chicago	2	0	0	Alabama:			
Michigan:				Birmingham	1	1	0
Detroit	3	0	0	Louisiana:			
Wisconsin:				New Orleans	1	0	1
Milwaukee	1	0	0	Shreveport	0	1	0

Dengue.—Cases: Charleston, S. C., 2.
Encephalitis, epidemic or lethargic.—Cases: Great Falls, 1.
Pellagra.—Cases: Winston-Salem, 1; Charleston, S. C., 2.
Typhus fever.—Cases: New York, 2; St. Louis, 1; Savannah, 2.

FOREIGN REPORTS

CANADA

Provinces—Communicable diseases—Weeks ended February 10, 17, and 24, 1940.—During the weeks ended February 10, 17, and 24, 1940, cases of certain communicable diseases were reported by the Department of Pensions and National Health of Canada as follows:

Week ended February 10, 1940

Disease	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Total
Cerebrospinal meningitis				3	1				1	5
Chickenpox		40		151	526	39	81	25	56	918
Diphtheria			1	7		14	1	1		24
Dysentery									6	6
Influenza		46			202	4			7	259
Lethargic encephalitis					1	1				2
Measles				231	533	225	3	1	43	1,0[illegible]6
Mumps				29	153	9	3	4		198
Pneumonia		3			61		4		13	81
Poliomyelitis						1				1
Scarlet fever		12	11	108	166	15	4	23	8	347
Trachoma									2	2
Tuberculosis	1	1	8	55	48	8	23	2		146
Typhoid and paratyphoid fever				12		2			1	15
Whooping cough		6	8	136	95	42	37	28	21	373

Week ended February 17, 1940

Disease	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Total
Cerebrospinal meningitis				2	3				2	7
Chickenpox		11	2	208	459	34	36	3	85	838
Diphtheria			2	34	1	11	4	4		56
Dysentery				1						1
Influenza		130			12	2			27	171
Lethargic encephalitis								2		2
Measles		1	1	104	461	301	4	17	34	923
Mumps				30	370	18	105			523
Pneumonia		13			21	1			7	42
Poliomyelitis				1						1
Scarlet fever		7	4	97	123	32	9	30	16	318
Trachoma						1			2	3
Tuberculosis	1	14	15	72	61	2	3			168
Typhoid and paratyphoid fever			2	8	1			1		12
Whooping cough		10	2	134	133	16	25	8	14	342

Week ended February 24, 1940

Disease	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia	Total
Cerebrospinal meningitis				1	2				1	4
Chickenpox		5		210	525	56	47	19	73	935
Diphtheria			4	14	3	21	3			45
Dysentery				1				1		2
Influenza		35			197	5			27	264
Measles		1		86	714	565	33	2	15	1,416
Mumps		1		71	430	21	46	2	3	574
Pneumonia	2	2			14	3			17	38
Poliomyelitis				1						1
Scarlet fever	1	19	12	97	137	12	4	14	2	298
Trachoma									1	1
Tuberculosis	1	6	9	91	57	4		1		169
Typhoid and paratyphoid fever				7	1	1	1			10
Whooping cough		3	5	117	91	26	37	22	18	319

Provinces—Vital statistics—Third quarter 1939.—The Bureau of Statistics of the Dominion of Canada has published the following preliminary statistics for the third quarter of 1939. The rates are computed on an annual basis. There were 20.2 live births per 1,000 population during the third quarter of 1939 as compared with 21.1 during the third quarter of 1938. The death rate was 8.3 per 1,000 population for the third quarter of 1939 and 8.7 for the corresponding quarter of 1938. The infant mortality rate was 53 per 1,000 live births for the third quarter of 1939 and 57 for the same quarter of 1938. The maternal death rate was 3.6 per 1,000 live births for the third quarter of 1939 and 4.3 for the corresponding quarter of 1938.

The accompanying tables give the numbers of births, deaths, and marriages, by Provinces, for the third quarter of 1939, and deaths by causes in Canada for the third quarter of 1939 and the corresponding quarter of 1938:

Numbers of births, deaths, and marriages, third quarter 1939

Province	Live births	Deaths (exclusive of stillbirths)	Deaths under 1 year of age	Maternal deaths	Marriages
Canada [1]	57,423	23,762	3,067	205	32,698
Prince Edward Island	566	204	34	5	193
Nova Scotia	2,778	1,117	138	6	1,463
New Brunswick	2,854	1,139	176	11	1,174
Quebec	19,737	7,481	1,426	83	10,341
Ontario	16,445	7,949	628	63	11,061
Manitoba	3,502	1,465	199	12	2,363
Saskatchewan	4,577	1,394	192	7	1,506
Alberta	3,865	1,274	164	12	2,089
British Columbia	3,099	1,739	110	6	2,508

[1] Exclusive of Yukon and the Northwest Territories.

Deaths, by cause, third quarter 1939

Cause of death	Canada[1] (third quarter)		Province								
	1938	1939	Prince Edward Island	Nova Scotia	New Brunswick	Quebec	Ontario	Manitoba	Saskatchewan	Alberta	British Columbia
All causes		23,762	204	1,117	1,139	7,481	7,949	1,465	1,394	1,274	1,739
Automobile accidents	490	519	2	23	34	143	221	24	21	20	31
Cancer	3,104	3,066	16	167	128	868	1,104	211	177	136	259
Cerebral hemorrhage, cerebral embolism, and thrombosis	460	425	5	25	49	83	184	13	27	18	21
Diarrhea and enteritis	1,017	1,006	12	23	88	598	147	60	38	33	7
Diphtheria	93	68			12	41	3	2	8	2	
Diseases of the arteries	2,231	2,296	15	89	101	457	1,037	165	127	131	174
Diseases of the heart	3,671	3,931	35	201	152	921	1,584	241	251	224	322
Homicides	32	37	1		2	5	10	2	7	3	7
Influenza	214	185	2	16	3	75	45	8	14	14	8
Measles	44	27			4	16	7				
Nephritis	1,383	1,367	14	62	45	641	378	48	49	49	81
Pneumonia	1,025	783	8	35	48	194	264	60	60	51	63
Poliomyelitis	41	24	1			4	12	2		3	2
Puerperal causes	256	205	5	6	11	83	63	12	7	12	6
Scarlet fever	27	17			1	7	4		2	3	
Suicide	235	253	1	9	3	43	94	20	31	20	32
Tuberculosis	1,447	1,376	13	87	64	622	276	71	46	57	140
Typhoid and paratyphoid fever	57	46		1	5	28	6	2		2	2
Unspecified or ill-defined causes		127	3	8	30	50	11	5	2	12	6
Violence	1,400	1,388	10	47	57	394	456	94	104	94	132
Whooping cough	101	109		20	4	39	14	12	10	8	2
Other specified causes		6,507	61	298	298	2,169	2,029	413	413	382	444

[1] Exclusive of Yukon and the Northwest Territories.

CUBA

Habana—Communicable diseases—4 weeks ended March 9, 1940.—During the 4 weeks ended March 9, 1940, certain communicable diseases were reported in Habana, Cuba, as follows:

Disease	Cases	Deaths	Disease	Cases	Deaths
Diphtheria	7		Tuberculosis	7	
Scarlet fever	1		Typhoid fever	21	2

Provinces—Notifiable diseases—4 weeks ended February 3, 1940.—During the 4 weeks ended February 3, 1940, cases of certain notifiable diseases were reported in the Provinces of Cuba as follows:

Disease	Pinar del Rio	Habana	Matanzas	Santa Clara	Camaguey	Oriente	Total
Cancer		3	3	3	1	10	20
Chickenpox	1	9		1		1	12
Diphtheria	6	18		1	4		29
Dysentery		6					6
Hookworm disease				1			1
Leprosy		1			3	1	5
Malaria	8			4	22	39	73
Measles		19					19
Poliomyelitis		3		3	1		7
Scarlet fever		1					1
Tuberculosis	15	52	17	10	3	43	140
Typhoid fever	10	59	4	13	7	46	139

DENMARK

Notifiable diseases—October–December 1939.—During the months of October, November, and December 1939, cases of certain notifiable diseases were reported in Denmark as follows:

Disease	October	November	December	Disease	October	November	December
Cerebrospinal meningitis		9		Mumps	96	159	174
Chickenpox	510	1,130	1,036	Paratyphoid fever	8	3	9
Diphtheria	136	165	146	Poliomyelitis	16	4	2
Dysentery	29	16	21	Puerperal fever	22	28	13
Epidemic encephalitis	1	1		Scarlet fever	1,234	1,283	826
Erysipelas	363	358	253	Syphilis	51	72	50
Gastroenteritis, infectious	1,515	1,300	1,024	Tetanus, neonatorum		2	3
German measles	141	151	163	Typhoid fever	1	1	3
Gonorrhea	764	675	639	Undulant fever	37	51	28
Influenza	5,722	6,074	5,699	Weil's disease	5	4	1
Malaria	1			Whooping cough	2,663	2,665	2,115
Measles	472	729	1,264				

FINLAND

Communicable diseases—4 weeks ended January 27, 1940.—During the 4 weeks ended January 27, 1940, cases of certain communicable diseases were reported in Finland as follows:

Disease	Cases	Disease	Cases
Diphtheria	316	Scarlet fever	440
Influenza	2,598	Typhoid fever	10
Paratyphoid fever	57	Undulant fever	2
Poliomyelitis	4		

REPORTS OF CHOLERA, PLAGUE, SMALLPOX, TYPHUS FEVER, AND YELLOW FEVER RECEIVED DURING THE CURRENT WEEK

NOTE.—A cumulative table giving current information regarding the world prevalence of quarantinable diseases appeared in the PUBLIC HEALTH REPORTS of March 29, 1940, pages 567–571. A similar table will appear in future issues of the PUBLIC HEALTH REPORTS for the last Friday of each month.

Smallpox

Mexico.—During the month of December 1939, smallpox was reported in Mexico as follows: Mexico, D. F., 3 cases; Monterrey, Nuevo Leon State, 12 cases, 5 deaths; Reynosa, Tamaulipas State, 1 case.

Typhus Fever

Mexico.—During the month of December 1939, typhus fever was reported in Mexico as follows: Aguascalientes, Aguascalientes State, 1 case; Mexico, D. F., 9 cases, 3 deaths; Queretaro, Queretaro State, 1 case; San Luis Potosi, San Luis Potosi State, 6 cases, 1 death.

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